# SUKHOI'S TUPOLEV DESIGNS

## ANT-5 FIGHTER PROTOTYPE

During the mid 1920s, the Air Forces called for a new fighter capable of competing with the best foreign aircraft In the autumn of 1925, Andrei Tupolev and Nikolai Polikarpov received an official request for a proposal for a new fighter aircraft A design group, headed by Aleksandr Putilov, was created at TsAGI

The duties within the group were shared as follows Aleksandr Putilov was busy with the fuselage and landing gear design, Nikolai Petrov handled assembly integration, Nikolai Nekrasov was responsible for the empennage, wing design was by Vladimir Petlyakov, Evgeny Pogossky was a head of aircraft equipment and Ivan Pogossky was responsible for the powerplant The task of designing the engine frame mounting was assigned to Pavel Sukhoi He was also designated as the leading engineerforthe aircraft

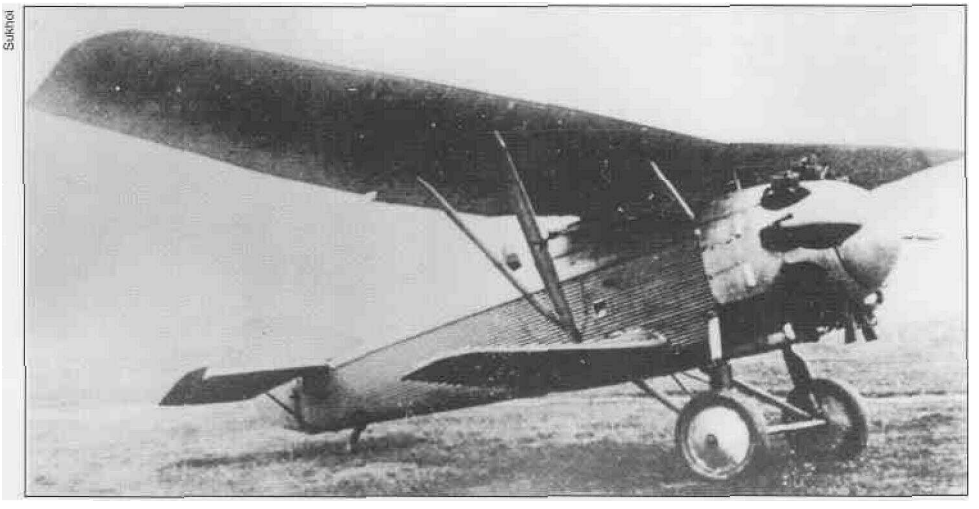
In two years, the first ANT-5 fighter (the designation ANT was derived from the initials of Andrei N Tupolev) was ready to fly This first Soviet all-metal fighter was powered by the air-cooled 420 hp (313 kW) Jupiter-IV piston engine Development tests were conducted from August 10 until September 27 by test pilot Mikhail Gromov After the tests were successfully accomplished, the aircraft was moved to the Nil VVS for official State Flight Tests eventually flown by test-pilots A Amsimov, A Yumashevand Ivan Kozlov

Test results exceeded all expectations The aircraft proved to be superior to the best foreign fighters Sea-level maximum speed was 153 mph (246 km/h) and speed at an altitude of 9,843 ft (3,000 m) was 155 mph (250 km/h)

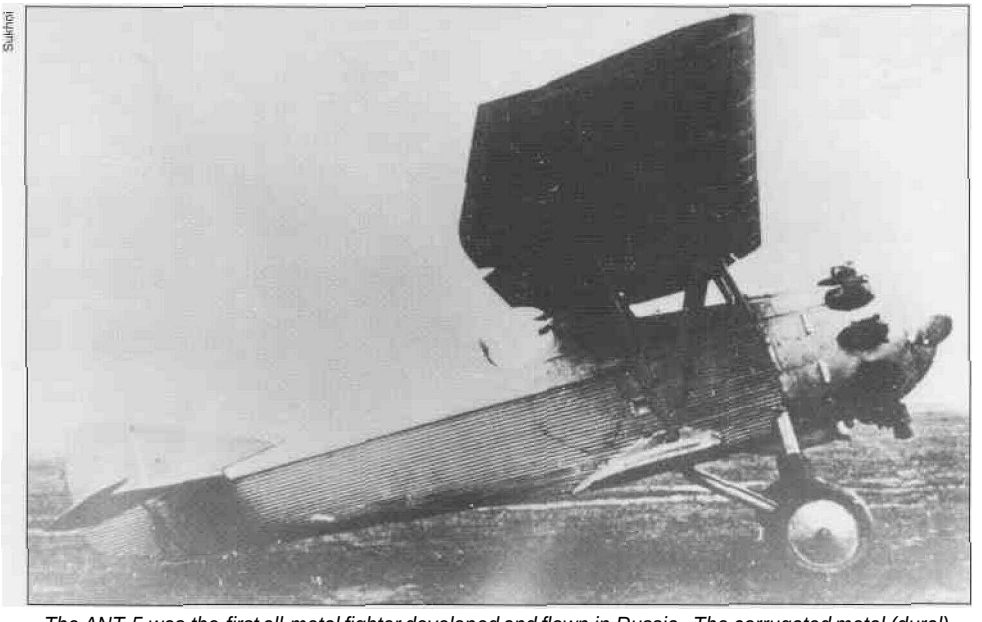
The ceiling was 27,100 ft (8,260 m) and the fighter climbed to an altitude of 16 404 ft (5,000 m) in 11 4 mm The decision to initiate series production of a new fighter, designated I-4, was made in December 1927, before the flight test program was completed

## I-4 SECOND PROTOTYPE FIGHTER

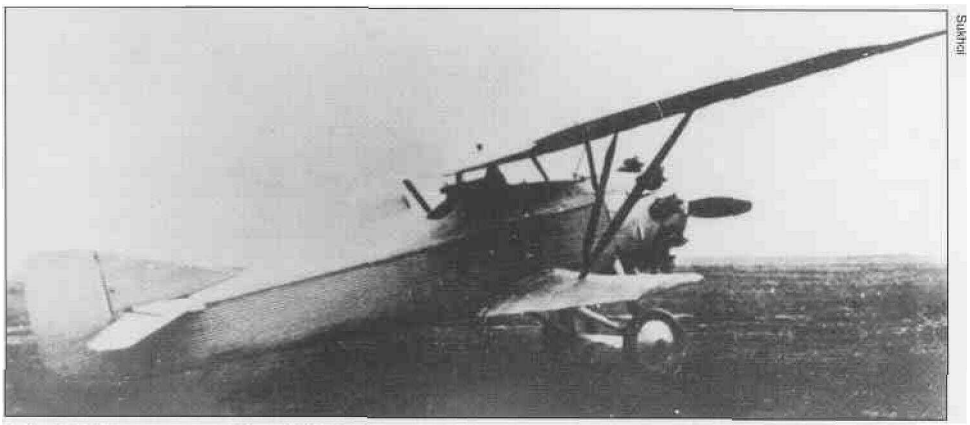
In August of 1928, the second I-4 prototype powered by a 480 hp (358 kW) Jupiter-VI engine was built This aircraft had detachable lower outer wing-panels A small center-wing section was integrated with the fuselage structure It permitted removal of the lower wing without the need to remove the landing gear Fuel tanks, with a total capacity of 1 1 1 gal (4201) of gasoline, were mounted from underneath Their installation was simplified in comparison to the first aircraft On the ANT-5 they were installed through the side door via a complicated traverse tube mounting The forward fuselage structure was completely redesigned for the convenience of machine gun ammunition loading, easy VOZ-1 and VOZ-2 radio installation and for the other equipment installation Two footholds were installed in place of the single one used on the first aircraft Engine cylinder fairings were installed during the flight tests which were conducted beginning December 1, 1928 Flight performance of the second prototype was improved by the more powerful engine The sea-level, the maximum speed became 160 mph (257 km/h) although at an altitude of 9,843 ft (3,000 m) the speed remained the same (155 mph)(249 km/h)



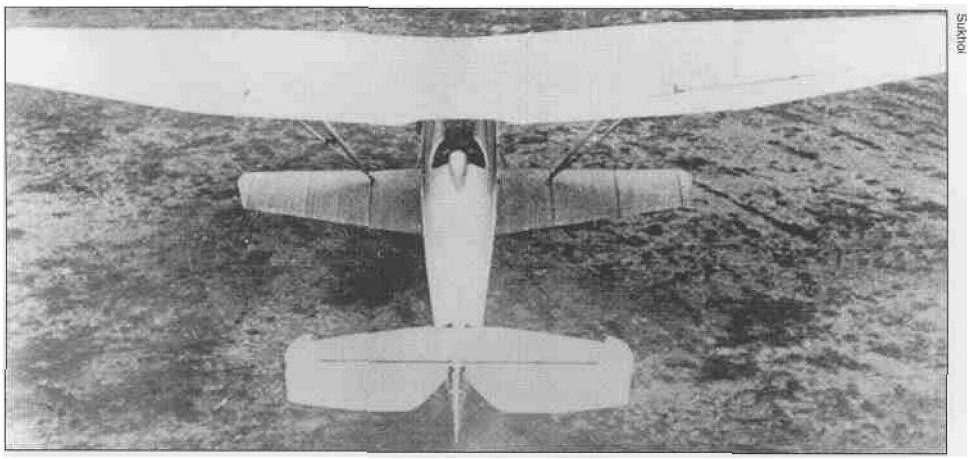

*Designed by Pa vel Sukhoi during his tenure with the Tupolev Design Bureau, the ANT-5 served as the I-4 fighter prototype*




*The ANT-5 was the first all-metal fighter developed and flown in Russia The corrugated metal (dural) fuselage was ofsemi monocoque construction*




*The ANT-5 was powered by a British air-cooled radial engine the* Jupiter IV *then one of the most powerful and dependable in existence*




*The ANT-5 was technically a sesquiplane rather than a conventional biplane in that its lower wing was of relatively diminutive span when compared to the upper*

*An improved version of the ANT-5 was equipped with the* upgraded Jupiter VI *radial Small span of lower wing is readily discernible in this view*

The service ceiling decreased to 25 098 ft (7 650 m) but the rate of climb increased This fighter could reach an altitude of 16,404 ft (5,000m) in 1 1 minutes

**PRODUCTION I-4 FIGHTER**

Pavel Sukhoi, as an official design bureau representative was sent to Factory No 22 to supervise I-4 fighter production This factory was named after the 10th October Revolution anniversary Series production of the Jupiter-VI powered fighter began in 1928 The actual weight of 3,123 lb (1,416 5 kg) exceeded the design weight of 3,653 lb (1,363 5 kg) Tests showed that the additional weight caused the fighter performance to deteriorate Maximum sea-level speed was 155 mph (249 5 km/h) service ceiling decreased to 23,260 ft (7 120 m), time to climb to an altitude of 16,404 ft (5 000 m) became 12 45 mm In spite of these figures, the I-4 fighter proved to be one of the best in the Soviet Union

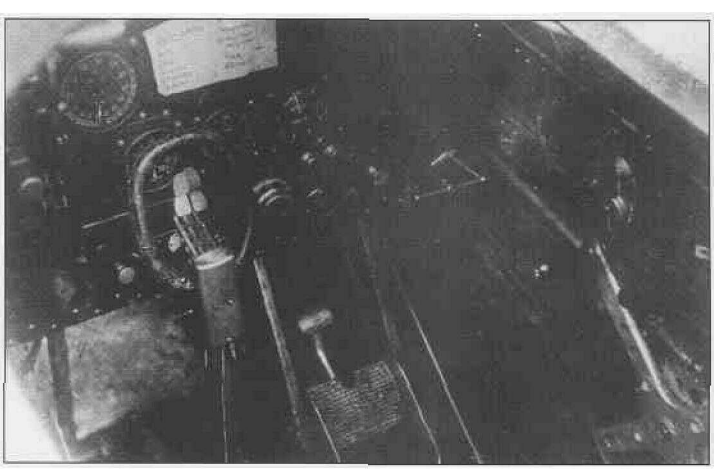
Production of the I-4, powered by both the Jupiter VI engine and its license version, the M-22, lasted for five years Factory No 22 built 242 aircraft and the total number of fighters built reached 370 The production I-4 weight increased even further to 3 153 lb (1,430 kg) and the sea-level speed decreased to 137 mph (220 km/h) Service ceiling was 23,294 ft (7 100 m) Rate of climb had decreased only slightly It now took the fighter 143 minutes to reach 16,404 ft (5 000 m) The high-speed turn rate was now 13 seconds, two seconds more than that of the second prototype

Operational experience with the I-4 made it clear that small aircraft had to have a smooth skin The corrugated skin, protruding ribs and wheel spokes considerably increased the aircraft drag Development experience with the I-4 proved to Soviet aircraft designers that all-metal fighter aircraft were not only technically feasible but were well advanced and promising

**I-4BIS FIGHTER PROTOTYPE**

Striving to improve fighter performance designers prepared the new, upgraded I-4bis fighter version for the flight tests m1931 The I-4bis prototype, a parasol monoplane was built at TsAGI Wing slats were operated from the cockpit They extended forward forming a slot with the wing and were the reason for the improvement in low speed stability A new engine

*The I-4 as a fighter became one of the first true combat aircraft to enter the official VVS inventory*




*The I-4 s cockpit was equipped with basic instrumentation and a British-style control stick (note circular grip)*

cowling featured separate cylinder fairings and Townend rings with added holes The use of such a ring fairing contributed greatly to a 20-50% reduction of the fuselage/engine drag

On September 6, 1931 the I-4bis was sent to Nil VVS flight test facilities and was flown for the first time on September 8 1931 Flight tests lasted from September 1 1 until September 23 They showed considerable improvement in the aircraft s performance Sea level maximum speed increased to 167 mph (268 5 km/h), speed at 9,843 ft (3,000 m) altitude was 158 mph (255 km/h) Service ceiling decreased to 22,966 ft (7 000 m) as a result of the monoplane configuration Rate of climb increased considerably It took only 107 minutes to get to 16,404 ft (5,000 m) altitude

Unfortunately, the slats were not implemented in the production version because this concept was thought to be ahead of its time The designers decided that the slats must be automatic in order not to increase the pilot workload Such an automatic system did not exist then in the Soviet Union This aircraft did not enter series production During the I-4 development and production, experiments were conducted with many variants

**I-4 VERSION FOR THE *VLADIMIR VAKHMISTROI* AIRCRAFT UNIT**

In 1929, the I-4 version intended for the aircraft-unit was built This modified version had a very small lower wing The aircraft-unit idea was suggested by Soviet aircraft designer Vladimir Vakhmistrov Fighters, carried by a TB-3 heavy bomber plane, were to detach from the bomber and protect it from enemy fighters as well as attack ground troops and antiaircraft artillery

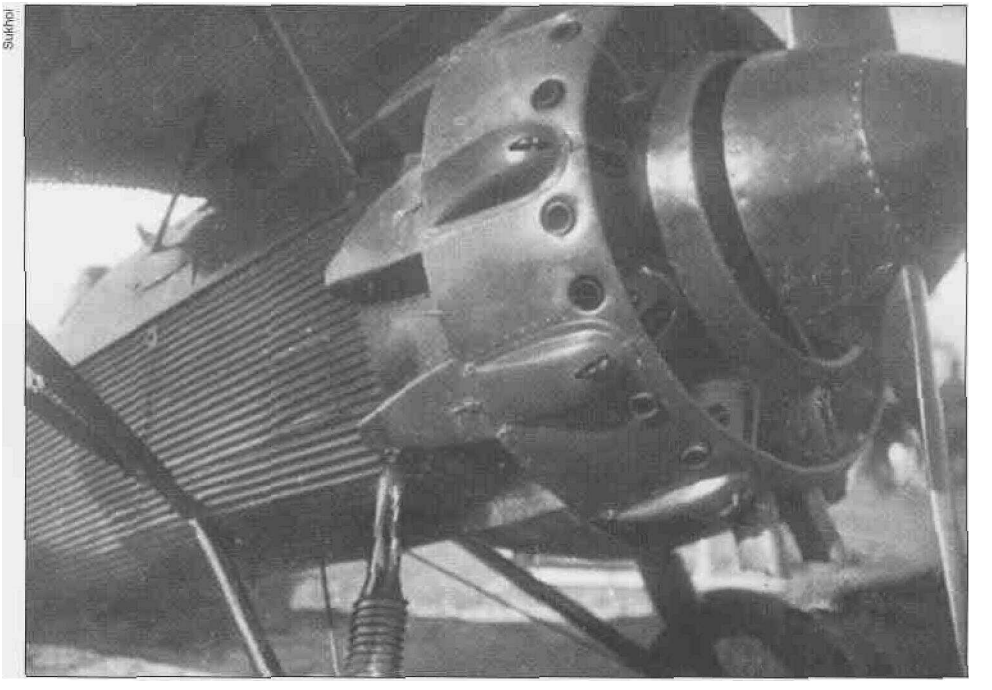
This idea was appreciated greatly by the Red Army's top ranking commanders Mikhail Tukhachevsky the People's Commissar of Defense, wrote to the Air Force Commander in Chief, Yakov Alksnis "It is a great invention It is necessary to make design predictions regarding the mission of the TB-1 and TB-3 at a 497-746 mile (800-1,200 km) range in order to estimate the total system effectiveness The inventor must be awarded a bonus "

Flight tests began on December 3 1931 Some well-known Soviet test-pilots, including Valery Chkalov, took part in the test program Two I-4 fighters were installed on each TB-1 wing, in a form of piggyback load, with Valery Chkalov and A Anisimov at the controls After the carrier aircraft climbed to the release altitude, one fighter succeeded in detaching However, a second fighter was damaged because of slipshod interaction between the bomber and fighter crews Nevertheless, the fighter was eventually released This experiment was considered successful

**I-4 FIGHTER PROTOTYPE ARMED WITH RECOILLESSGUNS**

In December 1931, one I-4 production fighter was equipped with two 76 mm recoilless guns designed by Leonid Kurchevsky They were mounted in the wings at a distance of 39 inches (1 m) from the bracing strut mounting points During the tests, one gun exploded However, experiments lasted until the I-4 was phased out of service

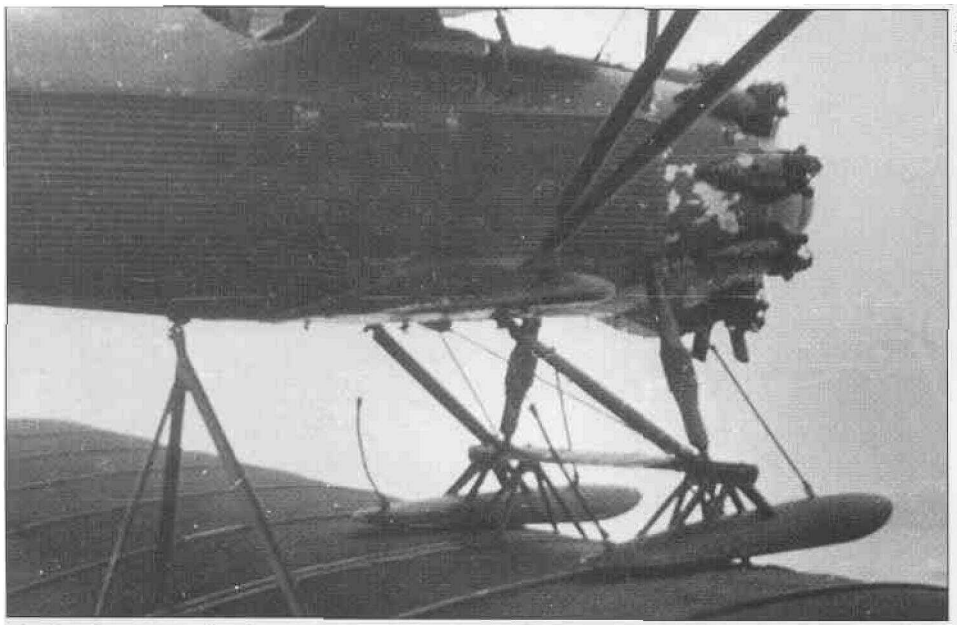
*The I-4bis was equipped with wing leading edge slats that could be activated from the cockpit The slats improved the! 4 slow speed landing and takeoff characteristics*




*Thel 4bis was powered by the Russian-built M-22 radial engine Complicated cowling design was based on NACA studies indicating reduced drag at high speed*

*The* V Vakhmistrov *aircraft unit was one of the select few in the Russian air force to be given specially modified I-4s optimized to be earned and launched from the wmgofa TB 1 twin eng/nebomber*

*Two I-4s could be carried by a TB-1 Transporting the fighters increased their range, but decreased the range of the transport Regardless, it was determined the presence of the fighters created legitimate protection for the otherwise virtually defenseless bomber*




During winter operations it was possible to equip the TB-1 -transported I-4s with ski-type landing gear for operation from snow and ice Noteworthy are the stub wings of the TB-1 -dedicated I-4s

with the Red Army Air Force

**I-4 FIGHTER POWERED BY THE BMW-VI ENGINE**

Reflecting an urgent demand by the Red Army Air Force for fighter planes and a shortage of the M-22 air-cooled engines a proposal was made to build some I-4 fighters powered by German water-cooled BMW-VI engines rated at 600 hp (447 kW) This aircraft version was developed but there is no information currently available about it According to a government letter dated May 1928, and signed by Deputy Commander in Chief of the Red Army Air Force, Yakov Alksnis, 75 I-4s of this configuration were to have been procured

**I-4 FIGHTER WITH FLOAT UNDERCARRIAGE**

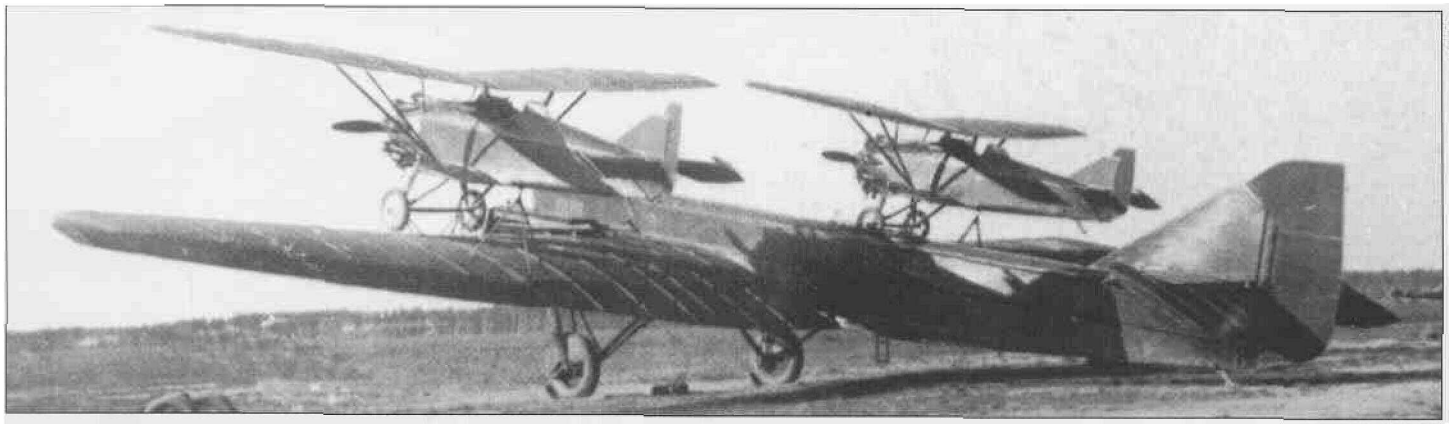
Floats, specially designed by AGOS TsAGI for the I-4, were built in 1931 They were installed on the aircraft on August 10 However, tests were not completed because it was decided that there was no demand for a fighter with a float undercarriage

**I-4 FIGHTER VERSION ARMED WITH ROCKETS**

In the summer of 1932 for the first time in the Soviet Union, 82 mm RS-82 rockets were tested using the I-4 fighter as a weapons platform The Peoples' Commissar of Defense Mikhai Tukhachevsky, observed test firing The results were considered positive Later, the RS-82 rockets entered the Red Army inventory and were widely used by Soviet fighters during World War II

**I-4 FIGHTER WITH ROCKET BOOSTERS**

In 1935 there was a need for short-term speed increases, or boosting, in air combat Work on rocket booster installation was initiated with the I-4 fighter The type and method of tests were chosen An I-4 aircraft




*Once positioned on the wing of the TB 1 the I 4s were rigidly supported by a lightweight mounting assembly Release of the aircraft in flight was accomplished manually by the pilots Clean separations proved relatively routine and there were few accidents or incidents*

was equipped with boosters designed by RNII (Rocket Scientific Research Institute) It was proposed to underslmg two boosters each with three solid fuel rockets mounted inside The next year these plans were interrupted and, consequently, were never accomplished

**I-4 DESCRIPTION**

The I-4 represented a class of single-seat all-metal, braced biplanes with small cantilever lower wings known as sesqui-planes

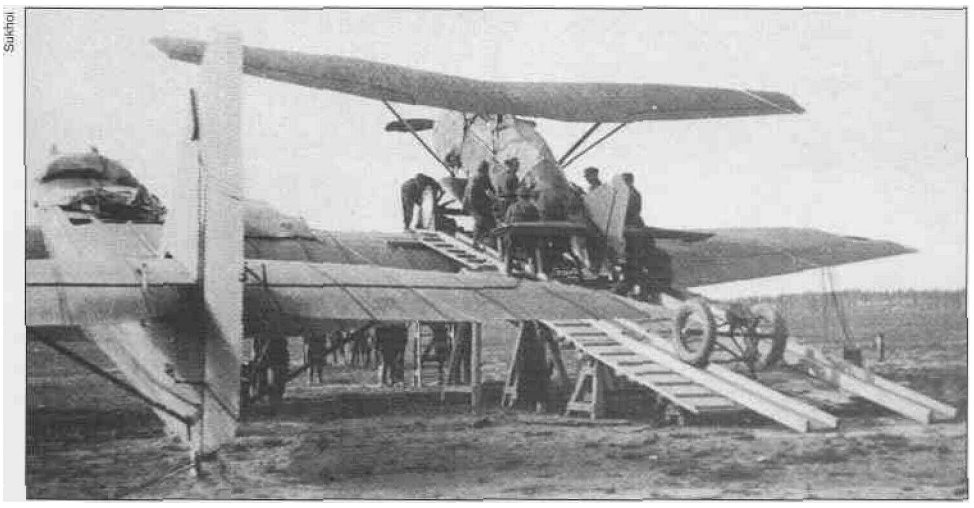
**Fuselage:** The conventional fuselage had a triangular cross section The power-plant was mounted in the nose The open cockpit was in the middle of the fuselage just behind the wing

**Wing:** The wings had an 18% thickness to chord ratio at the point where the bracing struts were installed and a 12% ratio at the roots and tips The upper three-spar wing had 10 ribs in each outer-wing panel Outer-wing sections of the upper wing were joined at the aircraft centerlme The upper wing was mounted via a narrow pylon and two V-shaped bracing struts extending from the lower wing Additionally, the upper wing was attached to the fuselage via stream-lined flying wires The lower wing could not be detached and was structurally integrated with the fuselage

**Empennage:** The conventional empen-nage consisted of a vertical fin equipped with the rudder and a horizontal tail equipped with the elevator The empen-nage was covered with corrugated skins

**Landing gear:** The landing gear con-sisted of two streamlined, wire-braced main gear struts and a tail skid Mam gear struts had simple rubber shock absorption and wheels of 29 53 x 1 97 in (750 x 50 mm) size Several production fighters were equipped with ski undercarriages from Dmitry Gngorovich I-2 fighters

**Powerplant:** The ANT-5 prototype was powered by the Jupiter IV engine rated at 420 hp (313 kW) The second prototype and the first production aircraft were equipped with the Jupiter-VI engine uprated to 480 hp (358 kW) The same engines powered series production aircraft As the Jupiter-IV entered license series production in the




*A wooden ramp assembly was utilized to roll the I-4 onto the wing oftheTB 1 during the mating process Note dolly for elevating I 4 tai/wheeloutofmud*

**ANT-5 AND I-4 SPECIFICATIONS AND PERFORMANCE**

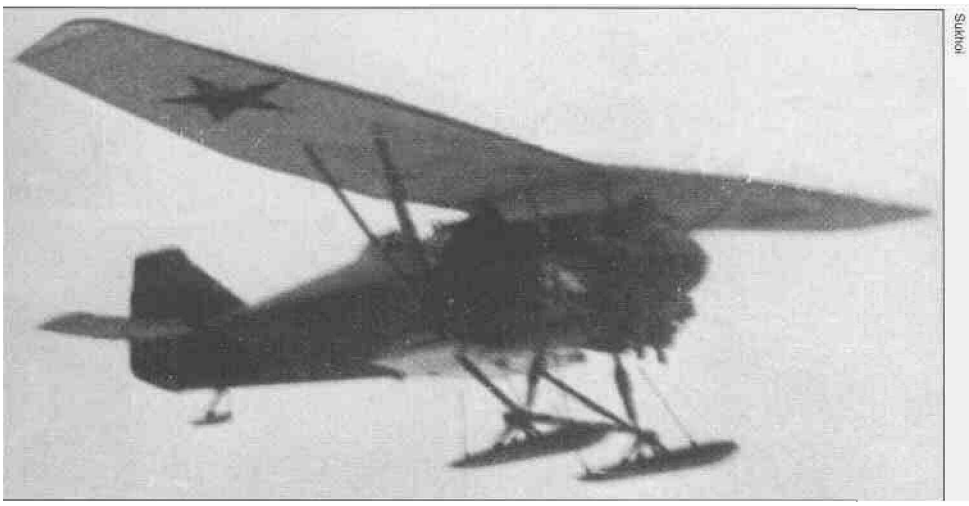
| | ANT-5 (I-4 Prototype) | I-4 (Production) |
|---|---|---|
| Powerplant | Jupiter IV | M 22 |
| Horsepower (kW) | 420(313) | 480 (358) |
| Wmgspan (upper) | 377(11 486) | 374(11 4) |
| Wingspan (lower) | 18 7 (5 7) | (?) |
| Length ft (m) | (?) | 2388(728) |
| Heightft(m) | (?) | 9 18(28) |
| Total wing area ft$^2$ (m$^2$) | 256 1 (23 8) | 256 1 (23 8) |
| Upper wing area ft$^2$ (m$^2$) | 213 1 (198) | (?) |
| Lower wing area ft$^2$ (m$^2$) | 43 (4 0) | (?) |
| Aileron area ft$^2$(m$^2$) | (?) | 27 3 (2 54) |
| Tailplaneareaft$^2$(m$^2$) | (?) | 31 (2 88) |
| Fmarea(m$^2$) | (?) | 5 8 (0 54) |
| Rudder area (m$^2$) | (?) | 164(1 52) |
| Elevator area (m$^2$) | (?) | 9 0 (0 84) |
| Max takeoff weight lb (kg) | (') | 33423(1 5165) |
| Takeoff gross weight lb (kg) | 2 960 (1 343) | 3 151 7(1 430) |
| Empty weight lb (kg) | 2030(921) | 2 1466(974) |
| Fuel weight lb (kg) | (?) | 697(316) |
| Oil weight lb (kg) | (?) | 86 (39) |
| Wing loading lb/ft$^2$ (kg/m$^2$) | 11 53 (56 5) | 12 1(592) |
| Power loading lb/hp (kg/hp) | (9) | 74(337) |
| Max speed mprt (km/h)@ s l | 153(246) | 137(220) |
| Max speed mph (km/h) @ alt | 155 @ 9 840 (250 @ 3 000 m) | 143® 16400 (231 @ 5 000m) |
| Time to 16,400 ft (5,000 m) in mm | 11 4 | 143 |
| Ceiling ft (m) | 27092(8260) | 23288(7 100) |
| Range mi (km) | n | 522 (840) |
| Takeoff distance ft (m) | 230 (70) | 2 952 (90) |
| Landing roll ft (m) | 459(140) | 689(210) |
| Armament | 2 x 7 62mm Vickers guns 2x500rpg | 2x7 62mm PV-1 guns 2x500rpg |

*The I-4/TB-1 mating process was accomplished using manual labor only No mechanical systems were employed*

*A mm iu ^ ten men was required to push the I-4 up the ramp and onto the wmgoftheTB-1*

*Initial flight trials of the I-4/TB-1 comb/nation took place during early December of 1931 Minimal diffi culties were encountered though takeoff runs were considerably extended*

*During December of 1931 a single I-4 was modified and equipped with two 76mm Kurchevsky machine guns mounted one meter (39 4 ) outboard of the upper wing strut attachment points*




*Aski equipped! 4 in flight following launch from a TB-1 Relatively low speeds of the two aircraft con tnbuted significantly to the safety of the operation*

Soviet Union, designated as the M-22 and rated at 480 hp (358 kW), the aircraft were equipped with these engines The two-bladed, 9 ft 2 in (2 8 m) diameter propeller was of wooden construction Aircraft fuel capacity was 1 1 6 gal (4391)

**Armament:** The two prototypes and the first production I-4 were armed with two 7 62 mm ( 30 cal) English Vickers machine guns with a total of 1,000 rounds of ammunition The next production aircraft were armed with the Soviet-built 7 62 mm ( 30 cal) PV-1 machine guns

**SINGLE SEAT I-8 (ANT-13) INTERCEPTOR FIGHTER**

In 1928 the Andrei Tupolev and Nikolai Polikarpov design bureaus were given a request for a proposal for the I-5 single seat fighter The Nikolai Polikarpov bureau was assigned the task of developing a fighter with a wooden airframe structure while Andrey Tupolev was responsible for designing a fighter with a hybrid wood and metal structure There were many other projects already underway so work on this fighter was not officially planned at AGOS TsAGI One engineer suggested that every designer should work for 70 hours without pay on the I-5 design and building The Air Force Department readily responded and set up requirements for the new fighter interceptor These requirements were officially approved in January 1930 The fighter developed by the Nikolai Polikarpov design group was given the I-5 code while the Tupolev Design Bureau designated its project as the I-8 (ANT-13)

Pavel Sukhoi was given responsibility for the technical guidance of the design and construction of the interceptor fighter designated Zhokey (Jockey) or *Obschestvenny samolet* (Public Airplane) The preliminary design and mockup were accomplished in a short time According to design predictions, the aircraft would have the record speed in the Soviet Union 193 mph (310 km/h) The I-8 design was a single seat fighter powered by a small water-cooled American Curtiss Conqueror piston engine rated at 600 hp (447 kW) (without reduction gearbox)

The I-8 was built by November of 1930 On December 12, test pilot Mikhail Gromov successfully flew the aircraft for the first time It took 10 32 mm for him to reach an altitude of 16404 ft (5,000 m) Take-off weight of the aircraft was 3,139 lb (1,424 kg)

Armament included two 7 62 mm ( 30 cal) PV-1 machine-guns Stainless steel was used in the airframe structure for the first time in the Soviet Union The wings had all-metal frame covered with fabric skins The wing box streamline wires were made of steel Spar caps were made of 2A stainless steel, the ribs were made of Duralumin and the fuselage truss was welded of chromium molybdenum tubes

Soon the aircraft was retrofitted A stabilizer control mechanism was installed and the oil cooler capacity was increased The retrofit was supposed to include the installation of a supercharged, alcohol cooled engine, a change in the wing shape and its airfoil section, installation of a propeller spinner, a closed cockpit canopy and the addition of fairings to the landing gear In August 1931, the engine, horizontal tail and landing gear were replaced and the flight tests continued

Only the fact that its development continued through 1932 is known about the fate of this aircraft design

**DIP (ANT-29) TWO SEAT CANNON FIGHTER**

On July 26, 1930, the Air Force Administration of the Red Army reported its preliminary requirements for a two-seat fighter armed with the 103 mm APK-8 recoilless gun designed by Leonid Kurchevsky to TsAGI The Air Force command envisioned the aircraft as capable of overcoming all Soviet and foreign production fighters in terms of its fire power

On June 26, 1931 the basic requirements were changed The fighter had to be capable of a maximum speed of 218 mph (350 km/h) an operating altitude of 16,404 ft (5,000 m), a service ceiling of 26,247 ft (8,000 m) and a range of 186 mi (300 km) Conceptual and preliminary design of the DIP fighter (DIP means *dvukhmestny*

*istrebitel pushechny* - two-seat cannon armed fighter designed at TsAGI as the ANT-29) began in 1932

On December 26 the Air Force Administration again changed the specifications for the fighter The goal for top speed was raised to 233 mph (375 km/h) There was also a requirement for the installation of four 7 62 mm ( 30 cal) machine guns (two in the nose fuselage and two in the rear fuselage for observer/gunner) By that time, some 1 2 percent of the airframe already had been built

Official review of the DIP design, powered by two M-34 engines rated at 750 hp (559 kW), was on January 8, 1933 The designers did not succeed in obtaining the design take-off and landing characteristics with such a heavy fighter The deficiency was especially drastic regarding the predicted landing speed of 56 mph (90 km/h)

On April 2, TsAGI raised its objections to the Air Force Administration and suggested its own alternate aircraft specifications The DIP aircraft had to be built by December 1, 1933 However, frequent changes in the requirements and the resulting numerous structural alterations reduced production readiness of the aircraft to 6 5% by the end of the year

Additionally, the empennage which had already been constructed was used for the multi seat MI-3bis prototype fighter which was then being built at TsAG I

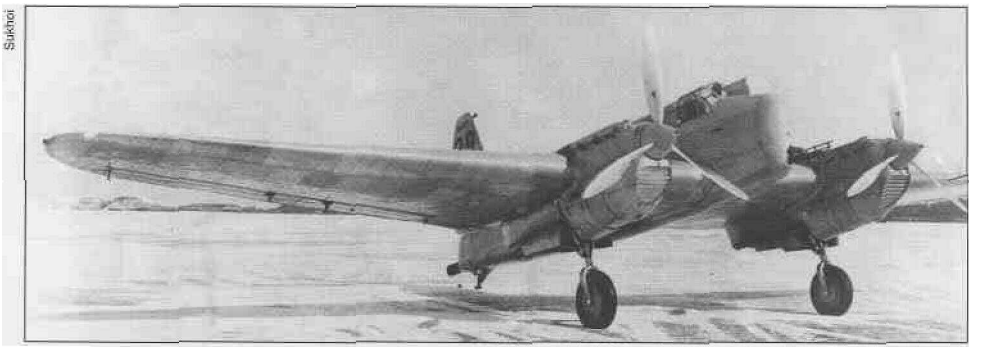
The main development work on the DIP fighter began in September 1934, and lasted until February 1935 During the development the designers had to replace the M-34 engine with the M-100 rated at 760 hp(567kW)

The test flights were conducted by test-pilot N Blagin, later to become well known *as* the culprit of the crash of the largest Soviet transport plane at that time the ANT-20 Maksim Gorky Tests revealed many deficiencies in the powerplant and in the empennage design After the introduction of a redesigned powerplant, a fin of increased area and empennage of a different shape on May 3, 1935, the designers again moved the aircraft to the test airfield

Smooth skin with flush riveting and the built-in 103 mm APK-8 recoilless gun may be considered the distinguishing features of the aircraft design The gun barrel went through the whole length of the DIP fuselage Because of the tests, the designers decided to increase the stabilizer area and reduce the area of the elevator while enhancing the effectiveness of the rudder To eliminate the aircraft s tendency to roll to the right, the ailerons were equipped with trim tabs

The radiators did not provide the required engine cooling and leaked after each landing Besides the inherent deficiencies mentioned above, the aircraft proved to be unstable throughout the range of possible operational CG positions It was pointed out in the official report on the flight tests The DIP aircraft must be considered efficient for experimental and scientific purposes with all shortcomings eliminated In March 1936 TsAGI received an order to stop work on the DIP aircraft development because of the number of design deficiencies and the cancellation of the APK-8 gun development

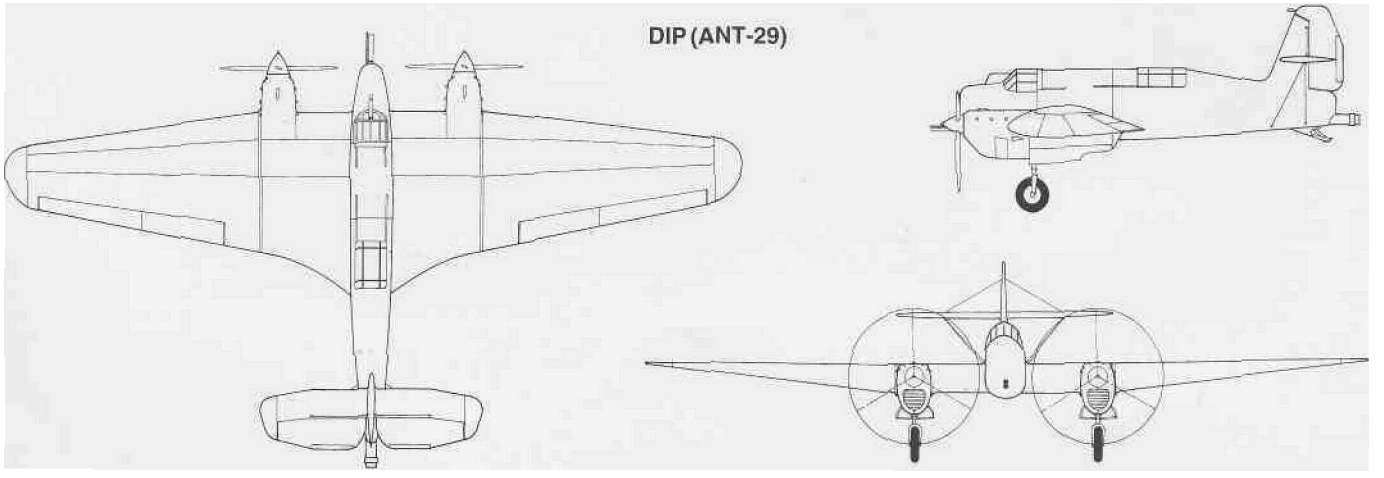
*I-8 was built ofdural and used fabric only where absolutely necessary It was comparable in many respects to the fighters then being produced in countries such as France and Germany*




*The DIP was equipped with a single 103mmAPK-8 rocket launcher twoforward firing? 62 ShKAS machine guns and a single aft-firing 7 62 ShKAS*

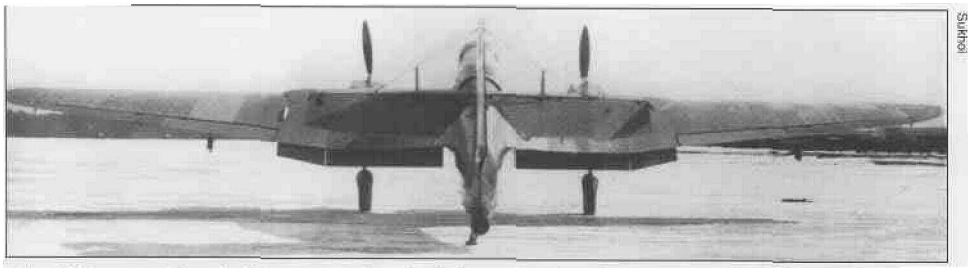
**DIP AIRCRAFT DESCRIPTION**

**Fuselage:** The primary structure of the all-metal fuselage consisted of 20 frames and a longitudinal framework which included several longerons and stringers A smooth skin with flush riveting covered the fuselage The APK-8 gun barrel extended

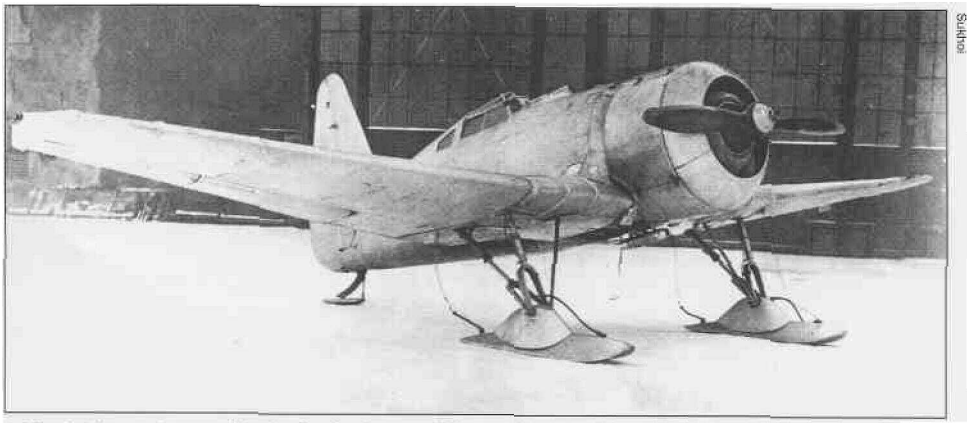


Sukhoi

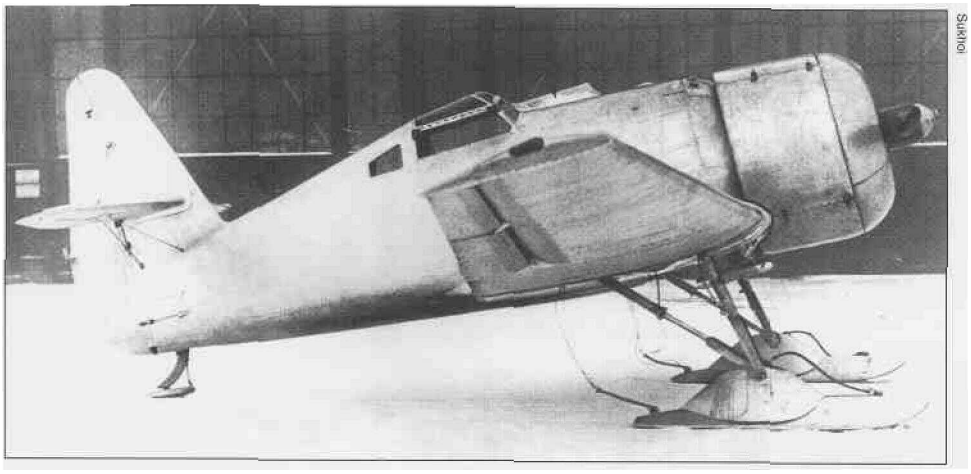
*The exhaust nozzle for theAPK-8 extended beyond the tailcone of the empennage and ran forward a/l the way through the fuselage*


Sukhoi

*The DIP was equipped with a conventional split flap under the wing center section Each flap segment ended at the beginning of the inboard section of each aileron*


Sukhoi

*Thel-14 an advanced design for its day could be equipped with ski type landing gear Thusconfigured however the landing gear could not be retracted*


Sukhoi

*The I 14 like several of its predecessors was powered by a British radial engine inthiscase the* Mercury VS2 *Ski bridles visible here are noteworthy*

from the lower nose of the fuselage The cockpit was equipped with a canopy made of panels of flat glass An upper canopy section slid backwards providing good access to the cockpit

The observer cockpit in the center fuselage section also had a sliding canopy The rear fuselage was integrated with a permanently attached vertical stabilizer A discharge nozzle for the compensating blast from the recoilless cannon extended from the tail fairing

**Wing and Empennage:** The low wing featured a center wing section and two outer wing panels which consisted of a set of ribs and three spars which formed the wing torsion box Each outer wing panel was equipped with ailerons in two sections on each side Four-sectioned air brake panels were installed on the wing between the fuselage and the ailerons The two engine nacelles were underslung at the ends of center wing section

A conventionally configured empennage consisted of vertical and horizontal tail units The rudder, with horn and mass balance, was installed on the integral fin An adjustable-incidence wire-braced tailplane was attached to the fin above the fuselage Elevators were equipped with trim tabs

**Powerplant:** The aircraft was powered by two 760 hp M-100 engines with all-metal, ground-adjustable 3 4 m dia propellers The engines were mounted in the front of the engine nacelle sections Radiators, equipped with controllable shutters were installed below the engines

**Landing gear:** Mam gear struts were mounted in the engine nacelles behind the engines They were attached to the wing front spar and retracted backwards such that part of each retracted wheel protruded from the bottom of the nacelles Most of the wheels and the gear struts were covered by the undercarriage doors The tail skid (without a tail wheel) was installed in the rear fuselage

**Armament:** The aircraft was armed with a single 103 mm APK-8 gun and two 7 62 mm ( 30 cal) ShKAS machine-guns mounted in the center wing section An observer had a single backwards firing ShKAS machine-gun for preventing enemy attacks from the rear

**DIP SPECIFICATIONS AND PERFORMANCE**

| | |
|---|---|
| **Powerplant** | **2x M 100** |
| **Horsepower (kW)ea** | **760 (566)** |
| **Wmgspanft(m)** | **6294(1919)** |
| **Length ft (m)** | **364(11 1)** |
| **Height ft (m)** | **180(55)** |
| **Wing area ft* ($m^2$)** | **2756 4 (56 86)** |
| **Wheel track** | **159(485)** |
| **Tailplane area ft$^2$ ($m^2$)** | **8944(831)** |
| **Fin area ($m^2$)** | **41 44 (3 85)** |
| **Fuel gal (l)** | **283(1 072 1)** |
| **Max speed mph (km/h)@ s l** | **183(296)** |
| **Max speed mph (km/h) @ alt** | **219@ 13 120 (352 @ 4 000 m)** |
| **Time to 16,400 ft (5,000m) in mm** | **96** |
| **Armament** | **1XAPK8 103mm cannon 3x ShKAS 762nm machine guns** |

**ANT-31 (I-14) PROTOTYPE FIGHTER**

Simultaneously with the development of record-setting airplanes the Pavel Sukhoi team continued work on fighter designs In 1932, the Sukhoi team received a request

for a proposal for a single-seat gun-equipped fighter with an enhanced weapon to outperform the best foreign fighters of its type It was designated the I-14 or ANT-31 with Andrei Tupolev's initials, who provided the general leadership of all aircraft projects atTsAGI

In May 1932, on the basis of aerodynamic predictions and preliminary design, TsAGI reported the estimated aircraft performance to the Principal Aircraft Industry Administration The full-scale development of an airplane and its mockup construction had begun in July L Osipov was appointed as Chief Engineer of the I-14 project The prototype building factory began production of separate assemblies in November 1932 In December, the Air Force Administration finally confirmed the aircraft operational requirements That airplane was estimated to have a maximum speed of 233-249 mph (375-400 km/h), a landing speed of 56-65 mph (90-105 km/h), a time to climb to 16,404 ft (5,000 m) of 7-8 minutes, a service ceiling of 29,528-32,808 ft (9,000-10,000 m) and a range of 155 mi (250 km)

The first prototype of the I-14 fighter powered with a Bristol Mercury VS2 engine rated at 520/580 hp (388/433 kW), had been manufactured by the middle of May 1933 It flew its maiden flight on May 27 with test-pilot K Popov at the controls

Several features differentiated that airplane from the previous fighters built in the Soviet Union The pilot's cockpit was heated and enclosed by a transparent, non sliding canopy which had a rearward hinging cap through which a pilot could enter Another feature was the APK large caliber underwmg guns designed by Leonid Kurchevsky The I-14 fighter had an airframe of mixed structure A smooth skin, which reduced the wet surface area and, consequently, the drag, covered the fuselage and fin

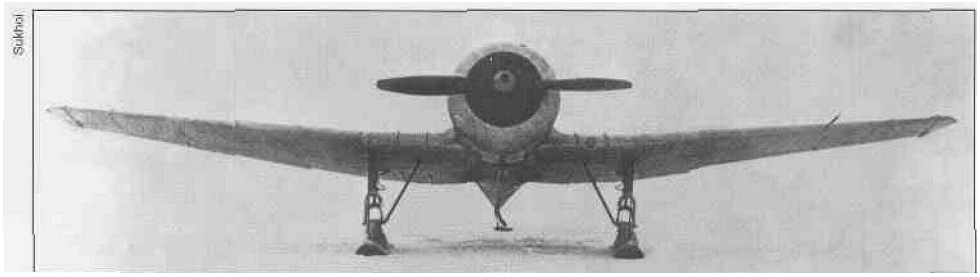
The wing and empennage were covered with a corrugated skin That prototype was the first all metal monoplane in the USSR on which smooth, stiffened skin with flush riveting was used That was an achievement of the TsAGI experimental factory The prototype fighter was built by skilled and experienced workers as well as by young assemblers who had been sent to the factory by Komsomol

To improve the aircraft's performance, Pavel Sukhoi used a retractable undercarriage and wheel brakes On June 8, the prototype fighter was given to TsAGI OALID for testing However, on July 17 the airplane was returned for upgrading which continued until September 30 The I-14 prototype fighter underwent tests but from September 25 until November 14 it was again being retrofitted

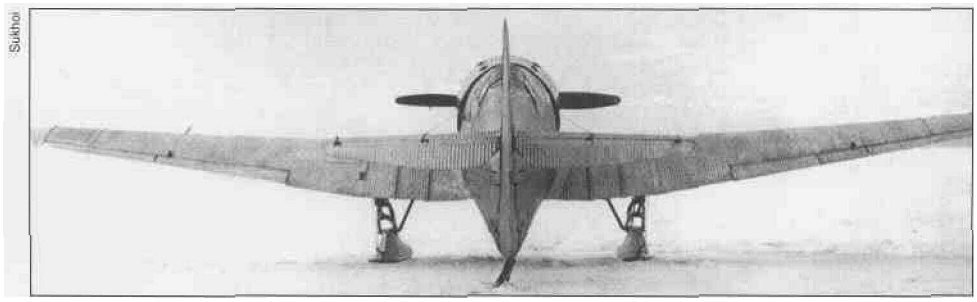
Official development flight tests of the first fighter were held from October 6 till December 13, 1933 A 9 ft 4 in (2 85 m) diameter variable-pitch propeller was installed on the airplane The I-14 had reached a maximum sea level speed of 196 mph (316 km/h) with a takeoff weight of 3,208 lb (1,455 kg) Speed at an altitude of 16,404 ft (5,000 m) was 239 mph (384 km/h) The service ceiling was reached in 8 03 mm The airplane received a positive evaluation and it was decided to begin the state testing

A problem arose during aircraft development with the Air Force Administration Military officials felt that the operational requirement could be better met by updating existing types of fighters Only because of the authority and persistence of Andrei Tupolev was the Sukhoi team able to produce a new airplane On that occasion Pavel Sukhoi wrote "The present configuration of the I-14 airplane is the first in our aviation history because, hitherto, we had no fighter-bombers When, in 1932, a question concerning the configuration of the

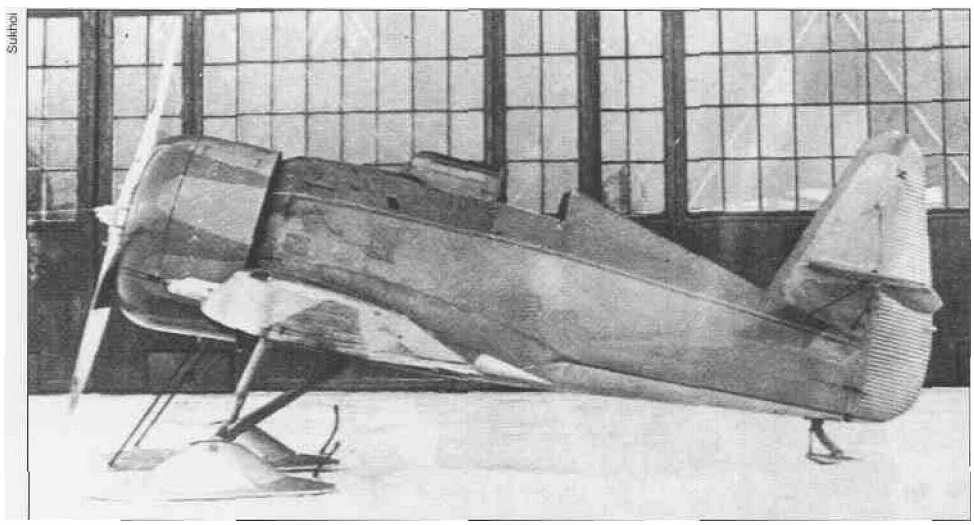
*Following initial trials, the I-14 undertook its official government flight tests during December of 1933 The results were favorable, but interest in upgrading older aircraft proved too strong to overcome*



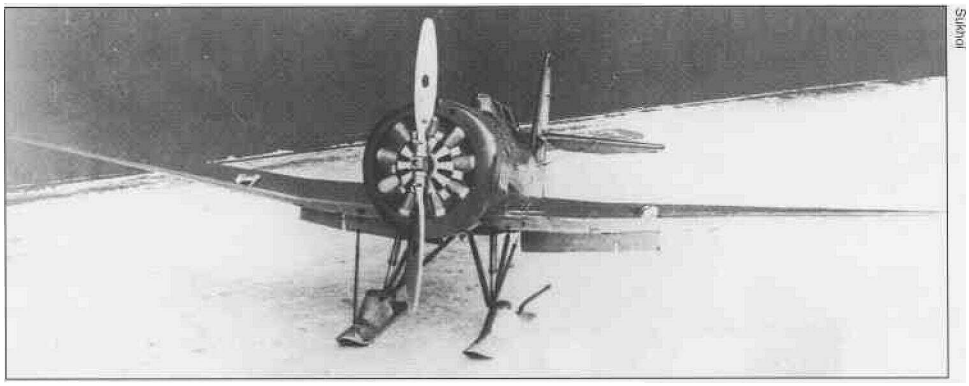

*Theski type landing gear on the I 14wasnon retractable The wells which normally accommodated the conventional gear assemblies were covered over with metal panels when skis were installed*



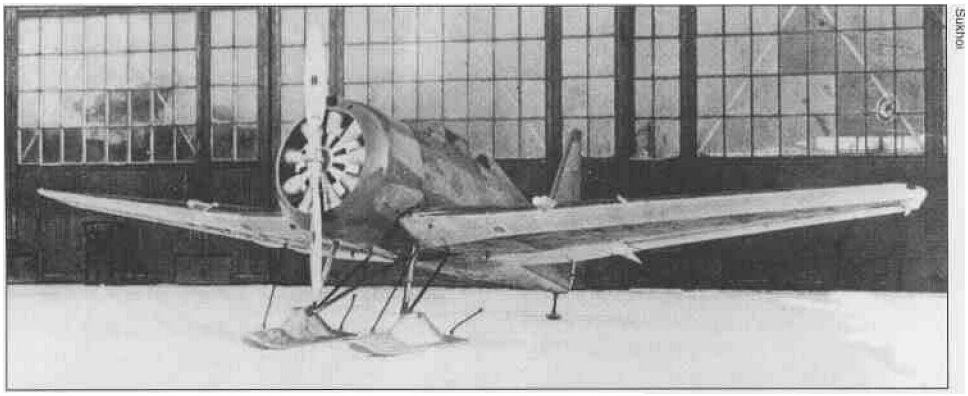

*The/ 14 also referred to as the ANT-31, was an all-metalaircraftandone ofthe first in Russia to be equipped with a fully enclosed cockp/t*



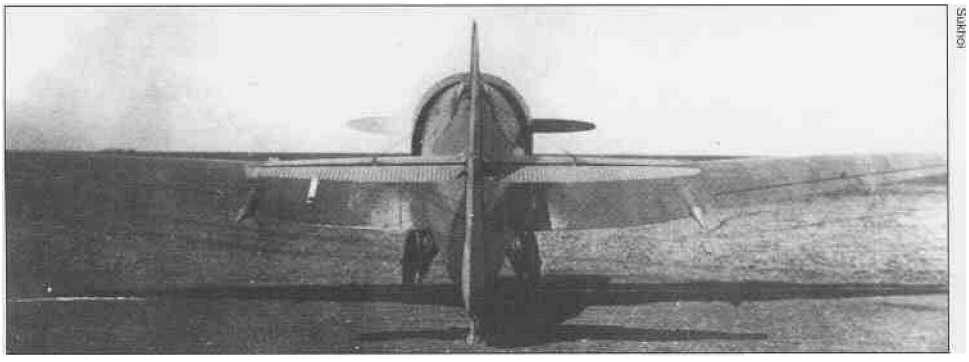

*The second prototype I-14, known as the I-14bis or ANT-31, was equipped with an American-manufactured Wnght* Cyclone *radial engine*



*Construction of the I-14bis was completed during February of 1934 The aircraft was similar in most respects to the original I-14 prototype with the exception of the engine and cockpit enclosure*



*The I-14bis had an open cockpit which was an item often preferred by pilots over the enclosed designs which were beginning to come into vogue as a result of aerodynamic requirements*



*The I-14b/s's rudder and elevator skins were of corrugated dural The rest ofth^ an^an uu,,zed conventionaldura/ without corrugation*

airplane arose, Andrei Tupolev was forced to endure pressure from the Air Force Administration which intended to update the I-4 (ANT-5) airplane Only the authority of Andrei Tupolev forced N 1 1 VVS to change its opinion and now summing up, one can say that we have produced an airplane that meets world standards"

**I-14BIS SECOND PROTOTYPE FIGHTER**

The second prototype of the ANT-31 fighter, designated as I-14bis, was ready to fly in August 1933 A Wright Cyclone F-2 engine, rated at 712 hp (531 kW) with an NACA type cowling, was installed on the aircraft The cockpit, of open type, differed from that of the first prototype and was more convenient for pilots N Fadeyev was appointed as leading engineer for the I-14bis program

The construction of the second prototype was completed on February 5, 1934 On February 13 the fighter had already been released for the flight test program that was to be carried out atOALID

The new airplane was chosen to participate in the Air Force parade on May 1, 1934, with a mixed group of fighters (e g , I-15, I-14, I-16) that flew in formation over Red Square The entire group flew over Red Square at an altitude of 984 ft (300 m) and then each aircraft performed a solo maximum speed flight at 492 ft (150 m) altitude with a subsequent zoom maneuver

On May 19, 1934, Yakov Alksnis, the Air Force Commander-m- Chief, signed the final report of the state flight test program of the I-14bis fighter A Film was the leading pilot, but Vladimir Kokkmaki, A Chernavsky and I Belozeorov also test-flew this aircraft The conclusion of the official test flight report read as follows "Due to its speed capability at 16,404 ft (5,000 m) altitude, the I-14bis fighter was one of the best fighters of this type worldwide, and though it had a bit worse speed at altitudes between 3,28I-9,893 ft (1,000-3,000 m) as well as ceiling and climb performance, its armament was considerably better than that of competing designs"

The second prototype was wrecked in May 1934 and had been passed on to the TsAGI experimental factory for repairs and maintenance During 1935, the aircraft was equipped with a new wing with leading-edge slats and a ground-adjustable variable-pitch propeller The aircraft also received a new electric ignition system for the engine and a new armament set with the APK guns being replaced by 7 62 mm ( 30 cal) ShKAS machine guns

Simultaneously, the designers had carried out design work and corresponding performance predictions for a reinforced wing with enlarged flaps All the necessary preparations to replace the old engine with a Wright Cyclone F54 and provisions for the installation of the new equipment had been accomplished It was planned that TsAGI would mount a new 20 mm ShVAK gun to the wing by May 20,1936

**I-14 SERIES PRODUCTION FIGHTER**

The decision regarding full-scale production of the I-14 fighter already had been made in November 1933 It implied that production was to be done at Factory No 21 in Gorky Therefore, a corresponding agreement between TsAGI and the above factory was signed According to that agreement, technical drawings would have been passed on to the latter to start the full-scale production The I-14 would have replaced the Nikolai Polikarpov I-5 fighter An initial batch of I-14 fighters would have consisted of 50 airplanes However, a new agreement had been signed between TsAGI and Factory No 125 in Irkutsk on December 14 After some hesitation, full-scale production of the I-14 was ultimately transferred to the No 125 factory

In 1936, the first series production aircraft had been delivered to the flight test department and the test program was completed at Nil VVS The conclusions of the military were as follows First, regarding flight performance and good handling qualities for takeoff, landing and aerobatics, the fighter was highly appreciated Nevertheless, because of dangerous spin performance it could not be adopted for the Air Force before this considerable technical shortcoming had been eliminated Second, it was recommended that TsAGI and Factory No 125 carry out all necessary research and technical improvements to eliminate the dangerous spin behavior After that they were to present the aircraft to Nil VVS again for the fighter test program

In 1936, several other series production aircraft of this type reached the status of State Flight Test as well These fighters were flown by test pilots Altynov and E Preman

Production aircraft were powered by Wright Cyclone F-2 and F-3 engines as well as with their Russian-built version the M-25 As a total, 55 aircraft were at the assembly shop but only 18 of them were completed and became serviceable with military units during 1936-1937 The assembly of the rest was not completed Due to the lack of a highly skilled work force,

the production I-14 fighter had poor quality skins, joints etc

When the new I-16 fighter had been built, the I-14 lost its importance because the newer fighter had better performance except for takeoff and landing maneuverability Nevertheless, the I-14 fighter had set a precedent in all-metal aircraft manufacturing in the Soviet Union and considerable experience had been gained in the utilization of smooth skins and in riveting

**I-14 FIGHTER DESCRIPTION**

**Fuselage:** A monocoque structure was used for the fuselage of the I-4 airplane The framework was made of aluminum angles of 0 02-0 03 in (0 5-0 8) mm thickness The longitudinal framework consisted of spars with curved profiles and the lateral framework consisted of frames A center wing section had a rigid truss joined by means of a spar to the tail section of the fuselage Engine mounting points were riveted to the upper spar on the first frame Smooth skin was used on the fuselage The cockpit was located in the central section just behind the wing trailing edge Although the prototype airplane had a closed canopy, the second prototype and production airplanes had an open canopy

**Wing:** The cantilever wing was made with a center wing section and two detachable outer panels Its longitudinal framework consisted of two spars of trussed structure with riveted tube caps All tubes were made of chromium-molybdenum alloys with heat treatment except the last, cone shaped, which was made of an aluminum alloy A transverse framework consisted of six main and five intermediate ribs Split landing flaps were placed between the second rib and the rib at the detachable joint Ailerons were internally balanced The prototype airplane had a corrugated skin but the second prototype and production airplanes had a smooth skin of flush riveted aluminum sheets of 0 02 in (0 5 mm) thickness

**Empennage:** The prototype airplane had a fin integral with the fuselage structure A joint was located in the upper part of the fin The second prototype and production fighters had a framework consisting of two spars and three ribs These aircraft had a smooth-skinned fin that was attached to the fuselage at two mounting points The rudder framework consisted of one spar of riveted aluminum profile and three ribs covered with a corrugated skin A tailplane framework consisted of two spars that were riveted assemblies of profiles and formed ribs It had two landing wires from above and four flying wires from below The elevator's framework consisted of one spar and a set of ribs The skin was corrugated and of 0 02 in (0 5 mm) thickness None of the control surfaces had balances

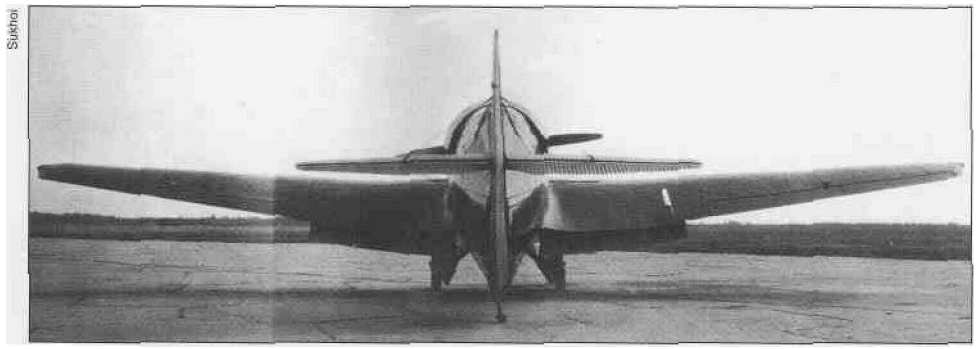
**Undercarriage:** The main gear was retracted into the center wing section in wheel wells which were enclosed by doors The extension and retraction were cable-driven The mam wheels were fitted with brakes A retractable tail skid was also cable-driven

**Powerplant:** Fuel and oil tanks were located in the fuselage in front of the pilot's cockpit The engine was mounted in the forward fuselage in front of the tanks An English made Bristol Mercury VS2 engine with a nominal power of 520 hp (388 kW) and maximum power of 580 hp (433 kW) powered the first prototype aircraft The second prototype airplane was powered with an American Wright Cyclone F-2 engine with a nominal power rating of 640 hp (477 kW) and a maximum power of 712 hp (531 kW) The early production aircraft were powered with Wright Cyclone F-3 engines (640/712 hp)(477/531 kW) and the later production aircraft had the Soviet version, the M-25 rated at 700 hp (533 kW) All types of engines were covered with NACA type cowlings

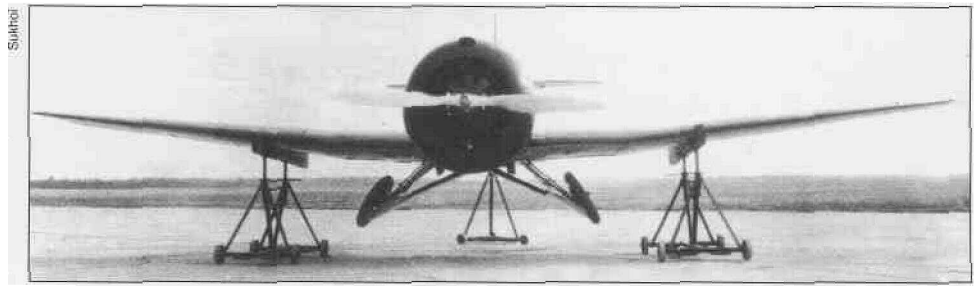
Wooden two-bladed propellers with ground-adjustable pitch were used on all aircraft

**Armament:** Armament of the first prototype airplane consisted of one 7 62 mm ( 30 cal) PV machine gun firing through the propeller's disk and two 37 mm APK-37 underwmg guns The second prototype was equipped with two 37 mm APK-37 underwmg guns Four D-1 bomb racks were also arranged on the airplane

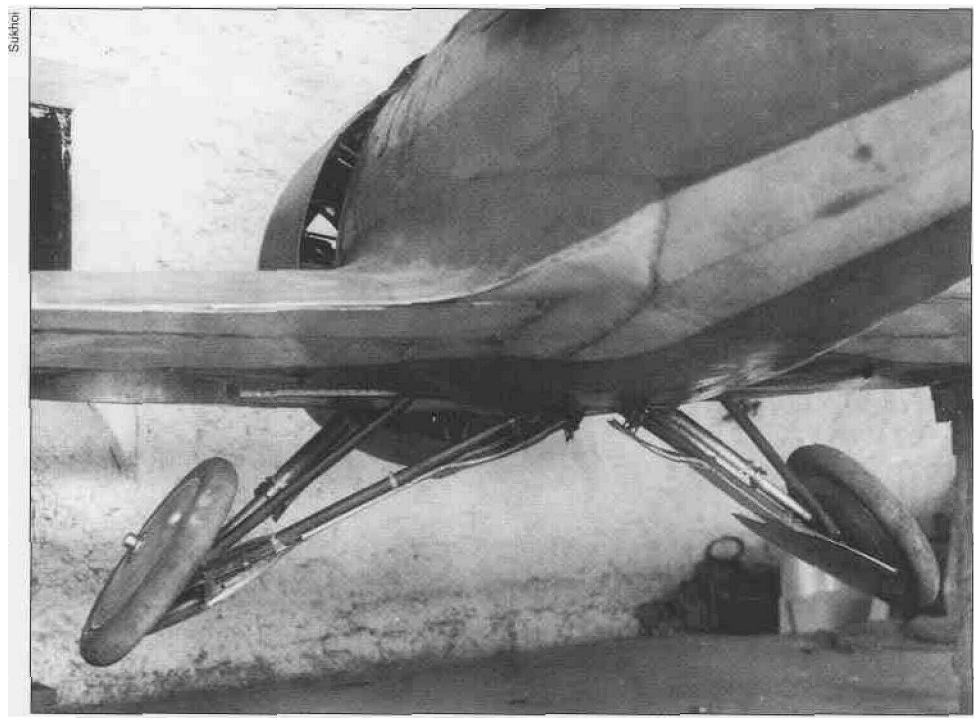
The I-14 production airplanes were armed with two ShKAS 7 62 mm ( 30 cal)




*Nil VVS I-14 acceptance trials were held during 1936 using the first production aircraft Performance was found to be acceptable*



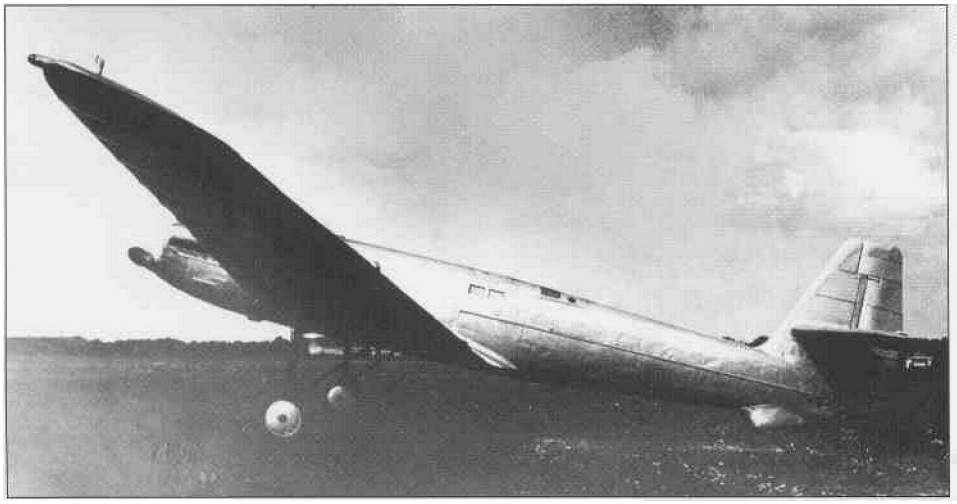

*Production I-14s were equipped with retractable landing gear The retraction sequence differed some what from more conventional arrangements in that the gear retracted outward into their wells*




*Bench testing of the I-14 main gear retraction sequence Gear well doors were attached to the main gear struts Narrow tread of tires is noteworthy*

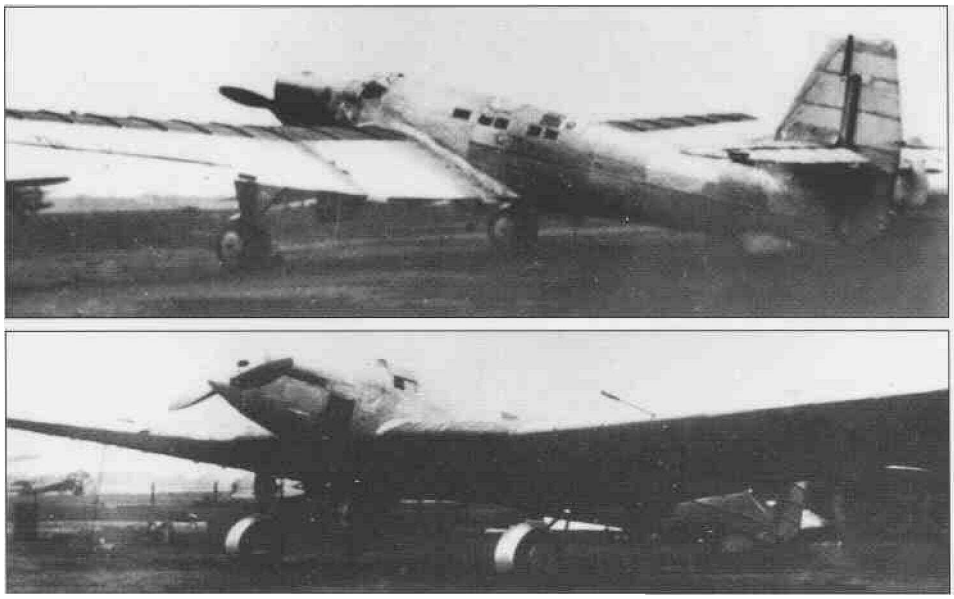
**ANT-31, I-14 bis, AND I-14 PRODUCTION SPECIFICATIONS AND PERFORMANCE**

| | ANT-31 (I-14 Prototype) | I-14 bis | I-14 Production |
|---|---|---|---|
| Powerplant | Bristol Mercury VS2 | Wnght Cyclone | WC F-3/M-25 |
| Horsepower (kW) | 580 (432) | 712(530) | 712/700(530/522) |
| Wmgspan (upper) | 369(11 25) | 369(11 25) | 369(11 25) |
| Length ft (m) | 21 19(646) | 20 04 (6 11) | 2004(6 11) |
| Height ft (m) | 11 02 (3 36) | 8 98 (2 74) | 1227(374) |
| Wing area ft$^2$ (m$^2$) | 169 19(1572) | 18082(168) | 18222(1693) |
| Tailplane area ft$^2$ (m$^2$) | 226(21) | 22 6 (2 1) | 226(21) |
| Vertical tail area (m$^2$) | 1722(1 6) | 1722(1 6) | 1722(1 6) |
| Takeoff gross weight lb (kg) | 3 206 8 (1 455) | | 3 394 2 (1 540) |
| cannon variant | | 3366(1 527) | |
| machine gun variant | | 3 277 3 (1 487) | |
| Empty weight lb (kg) | 2 321 (1 053) | 2 303 2 (1 045) | 25765(1 169) |
| Fuel weight lb (kg) | (?) | 309(140) | (9) |
| Oil weight lb (kg) | (?) | 44(20) | (?) |
| Max speed mph (km/h)@ s l | 1962(316) | 222 3(358) | 232 9(375) |
| Max speed mph (km/h) @ alt | 2384® 16400 (384 @ 5 000 m) | 231 ©16400 (372 @ 5 000 m) | 277 @ 1 1 1 52 (449@3400) |
| Time to 1 6,400 ft (5,000 m) in mm. | 803 | (9) | 65 |
| Ceihngft(m) | 30 832 (9 400) | 28 864 (8 800) | 30 898 (9 420) |
| Takeoff distance ft (m) | 394(120) | 246(75) | 722/853 (220 260) |
| Landing roll ft (m) | 722 (220) no brakes | 394(120) | (') |
| Armament | | | |
| Cannon | 2xAPK5(75mm) | 2XAPK-11 (APK37)or | 2XAPK-11 (?) |
| Machine guns | PV-1 (7 62mm) | 2xPV1 (7 62mm) | 2xShKAS (7 62mm) |
| Bombs | (?) | 4xAO 10 | 4xAO-10 |



Sukhoi

*The first ANT-25 was powered by an AM-34 liquid-cooled engine The engine differed from that used on later configurations in that it had no reduction gearbox*



Sukhoi

Sukhoi

*The first ANT-25 was built with a wing that used external corrugations for structural stiffness Parasitic drag proved considerably higher than originally anticipated and performance suffered accordingly*

machine guns firing through the propeller disk and two 45 mm APK-11 or 37 mm APK-37underwmgguns

**RD (ANT-25) LONG RANGE RECORD AIRCRAFT**

During the spring of 1931, a restructuring of the entire Soviet experimental aircraft industry and a search for an optimum organizational structure of the design bureaus began Thus an attempt was made to centralize the whole design process and merge the TsAGI with the Central Design Bureau However, this consolidation did not take place In 1932, the TsAGI Aero-Hydrodynamic Department Sector AGOS was transformed into the Experimental Aircraft Building Sector Design Department (KOSOS) with its own TsAGI prototype factory

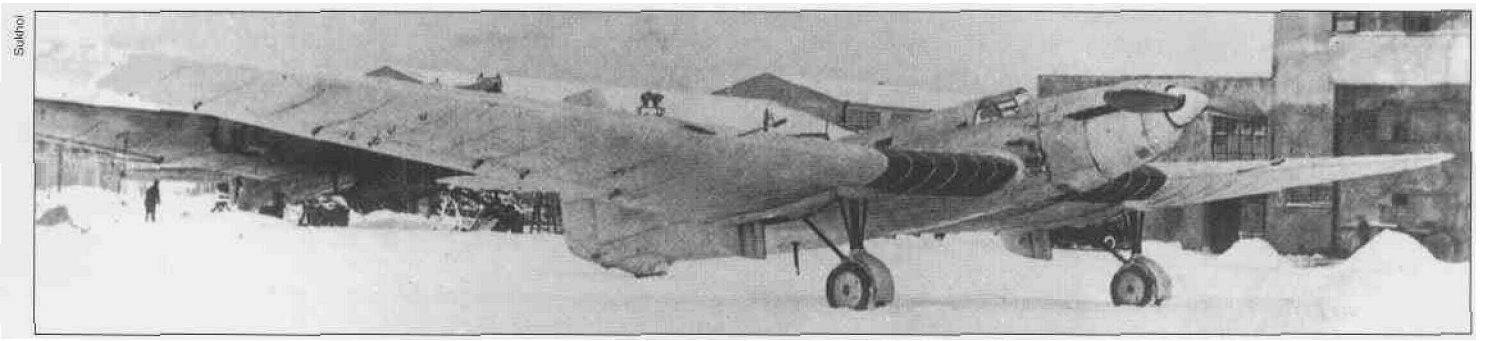
Somewhat earlier, on December 7, 1931 Klim Voroshilov suggested to the Government that a special aircraft with a maximum range of 8,078 miles (13 000 km) should be built The idea was approved Andrei Tupolev started developing the preliminary design On April 8 1932 at the conference which authorized the RD (ANT-25) record-setting aircraft, Pavel Sukhoi was selected to be head of the design and construction team Sukhoi was also the leading engineer for the project On May 4, 1932, by a TsAGI order, Sukhoi was named Chief of the KOSOS team No 3 (in 1935 it became the Design Bureau No 3, or KB-3) that was charged with the RD development work

Vladimir Petlyakov and Victor Belyaev were made responsible for the wing structural design They carried out most of the theoretical work on the strength of an extremely high-aspect ratio wing The design of the engine-propeller combination was led by engineers Evgeny Pogossky and K Mmkner Designers that later became famous also took part in the development of parts of the aircraft

The preparation for transit flights demanded great efforts from the engineers both from the maintenance and the test side This work along with the flight plans was done by engineers E Stoman and M Tails Theoretical problems were solved by the TsAGI group under the leadership of the prominent Soviet scientist professor V Vetchmkin

The Central Institute of Aviation Motors (TslAM) was set up during 1930 for scientific research in the field of engine construction During 1931, the AM-34 air cooled 750 hp (559 kW) vee engine was constructed by this institute under the direction of engine designer Aleksandr Mikulm At that time, aircraft all over the world were using engines with a maximum of 500 hp (373 kW) This engine was chosen for installation on the RD aircraft then under design development

The RD was conceived and built as an all-metal single-engine low-wing monoplane with a very high aspect ratio wing The wing span-to-chord ratio exceeded 13 Such a ratio was required to obtain maximum aerodynamic efficiency or hft-to-drag ratio Wing drag of aircraft then existing was often equal to half the drag caused by the entire aircraft It was very difficult to design a wing of such shape but the specialists of the TsAGI Structural Analysis Department




*The second ANT-25 which incorporation many changes and improvements was nicknamed the* Doubler *and was equipped with an uprated AM-34 This engine also incorporated a reduction gearbox which significantly changed the aircraft s nose contours*

managed to solve the problem The wing turned out to be lightweight and strong

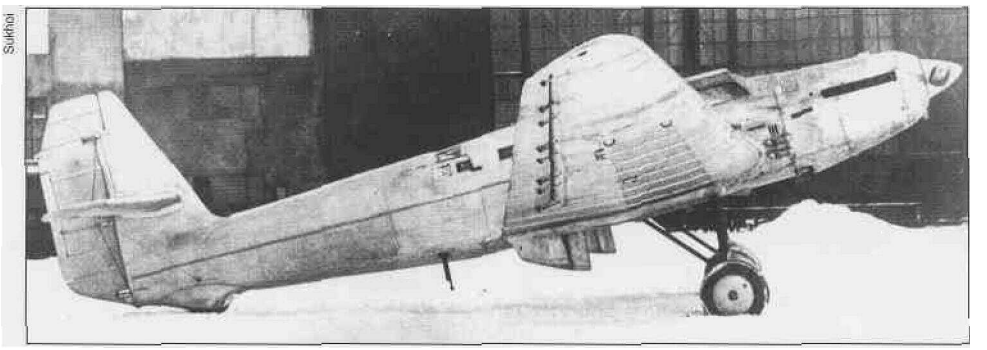
An impressive quantity of fuel, 52% of the aircraft TOGW, was carried in the wing This not only allowed space in the fuselage and made it easy to locate the crew and necessary cargo but it also made the structure lighter thus relieving wing loads The spanwise distribution of fuel loads placed them near the point of maximum lift thus resulting in more efficient use of the wing structure

Investigations of high aspect ratio wings led to a new chapter in the history of Russian and Soviet aerodynamics concerning aircraft structural vibration problems Among the theoretical analyses associated with the building of the RD the structural vibration studies were especially interesting and essential

To obtain the maximum flight range it was necessary to build an aircraft wing with an aspect ratio as high as possible No high performance aircraft existed at that time with such unusually narrow and long wing panels before the RD However, concern had been raised in technical journals over flutter problems with such high-aspect-ratio wing designs Flutter, as it was subsequently determined, occurred if the flight speed exceeded a certain value for the particular structure involved, i e, a critical speed The designers of the RD naturally were apprehensive that due to the high aspect ratio wing, the critical speed would be very low

To solve this problem, a special flutter investigation group headed by Mstislav Keldysh was formed within the TsAGI Experimental Aerodynamic Department At that time there was no way to predict flutter There were two approaches that might lead to the solution of this problem One could examine a particular case the RD wing, experimentally and determine possible measures for preventing wing flutter Another approach would be to create a general theory of the phenomena and on the basis of that theory, a design technique that could be applied to any particular case Mstislav Keldysh and his associates chose the second approach to create a general theory to solve the flutter problem

The design of the aircraft was completed during 1932 and the construction of the prototype began in June the same year Two prototypes were built simultaneously The first one, equipped with a 750 hp (559 kW) engine uprated to 874 hp (652 kW) took off for the first time one year later The second prototype fitted with the M-34R geared engine, began its flights in September of the same year




*With the change to the geared AM-34 the engine cowling was improved aerodynamically Additionally the transparencies were redesigned and the cockpit windscreen was reconfigured to reduce drag*

During the flight tests, the designers were astounded when the flight speed and range were lower than specified The problem was that the total wetted wing surface had been greatly increased due to the use of a corrugated skin This resulted in a considerable increase in the drag and a resulting reduction in the flight speed and range The cause was determined quickly

To solve the problem, the wing was covered with linen and coated with varnish Elongated fillets were added to blend the wing into the fuselage

As compared to the prototype, the second prototype had some structural differences Due to the installation of the geared engine, its cowling was altered The cockpit view was improved by increasing the area of glazing During flight tests, the vertical stabilizer was enlarged and various rudders were tried

Although the aircraft was still under development, it was already considered one of the outstanding achievements of Soviet aeronautical science and technology

Grand transit flights started on June 30, 1934, after a series of training flights The crew included the pilots Mikhail Gromov and A Film and the navigator I Spirm The first official flight of the ANT-25 aircraft (the second prototype) set a USSR record by covering a range of 2 774 miles (4,465 km) in 27 hours and 21 minutes On June 24, that same year, the crew claimed a new USSR record by traversing a range of 4,076 miles (6,559 km) in 39 hours and one minute

The aircraft took-off from an airfield near Moscow equipped with a special take-off strip At the beginning of the runway, a specially profiled concrete ground ramp was built to help takeoff From September 12 until September 15 the crew accumulated 75 flight hours flying the RD along the route between Moscow, Ryazan and Kharkov and covering a range of 12,441 km This considerably exceeded the record established by the French pilots Bosseau and Rossi Pilot M Gromov was declared a Hero of the Soviet Union for this achievement

The same year, the famous pilot S Levanevsky, a Hero of the Soviet Union, expressed in the press the idea of a transpolar flight from the USSR to the USA and began preparation for such a flight Besides the flight tests engine tests were done on the full-scale engine test stand Due to the preparations of the RD aircraft for the flight to the USA, Pavel Sukhoi was made responsible for the design work by an order issued

*Though of all-metal construction the wing was covered with a smooth fabric and par/nted The resulting surface was extremely smooth and created little residual parasitic drag*

*The crew of the ANT-25 during its first trans-Arctic flight attempt was commanded by famous Russian pilot, S. Levanevsky.*

*The* Doubler *took off on its record flight on June 20, 1936. The command pilot was V. Chkalov.*

by the People's Commissar of Heavy Industry, Sergo Ordjonikidze.

During 1935, the crew, consisting of pilots Sigizmund Levanevsky and Georgy Baydukov and navigator V. Levtchenko, attempted to conduct a flight from the Soviet Union to San Francisco. The aircraft had passed a range of 1,243 miles (2,000 km) and was over the Barents Sea when there appeared evidence of oil leakage from the engine. The aircraft commander turned back and landed near Novgorod. Baydukov, who had much experience with blind flights, saw that the oil had stopped leaking and decided that the engine was operating properly. He tried to persuade Levanevsky not to abort the mission.

Sigizmund Levanevsky stated that it was impossible to fly a single-engined aircraft over the North Pole and, after that, interest in such aircraft faded away in the Soviet Union. It was thought that it was dangerous to use such an aircraft for long range and complicated flights. A decision was made to use multi-engined aircraft for such flights, which was then done, but in vain. Therefore, attempts at setting records with either type of aircraft were ignored for several years.

The famous Soviet pilot Valery Chkalov wrote Joseph Stalin a personal letter saying that such flights should be resumed. Stalin responded by offering to approve a flight within the country. Thus, the Moscow-to-Franz Joseph Land-to-Petropavlovsk-Kamchatsky route, known as the Stalin route, was born.

For this purpose, the second prototype was modified during 1936 to receive the M-34R ducted water cooled engine. Controllable shutters were mounted ahead of the air cooler. The two-bladed wooden propeller was replaced with a three-bladed metal one which had given the best results out of the series tested. Backup controls were installed at the navigator station.

The engine cowl bottom was reworked so that it could be raised or lowered from the cockpit. The aircraft also was modified for water landings.

According to the conclusions made by TsAGI, the modifications resulted in the following improvements of the RD performance: the range increased by 7%; the ceiling increased 1,312 ft (400 m) with the landing gear retracted (at a weight of 19,842 lb (9,000 kg), the aircraft could fly at 11,483 ft (3,500 m) with a great rate-of-climb margin); the flight speed in long-range flight improved by 8%; the efficient altitude zone was broadened; the engine rpm in long-range flight was lowered.

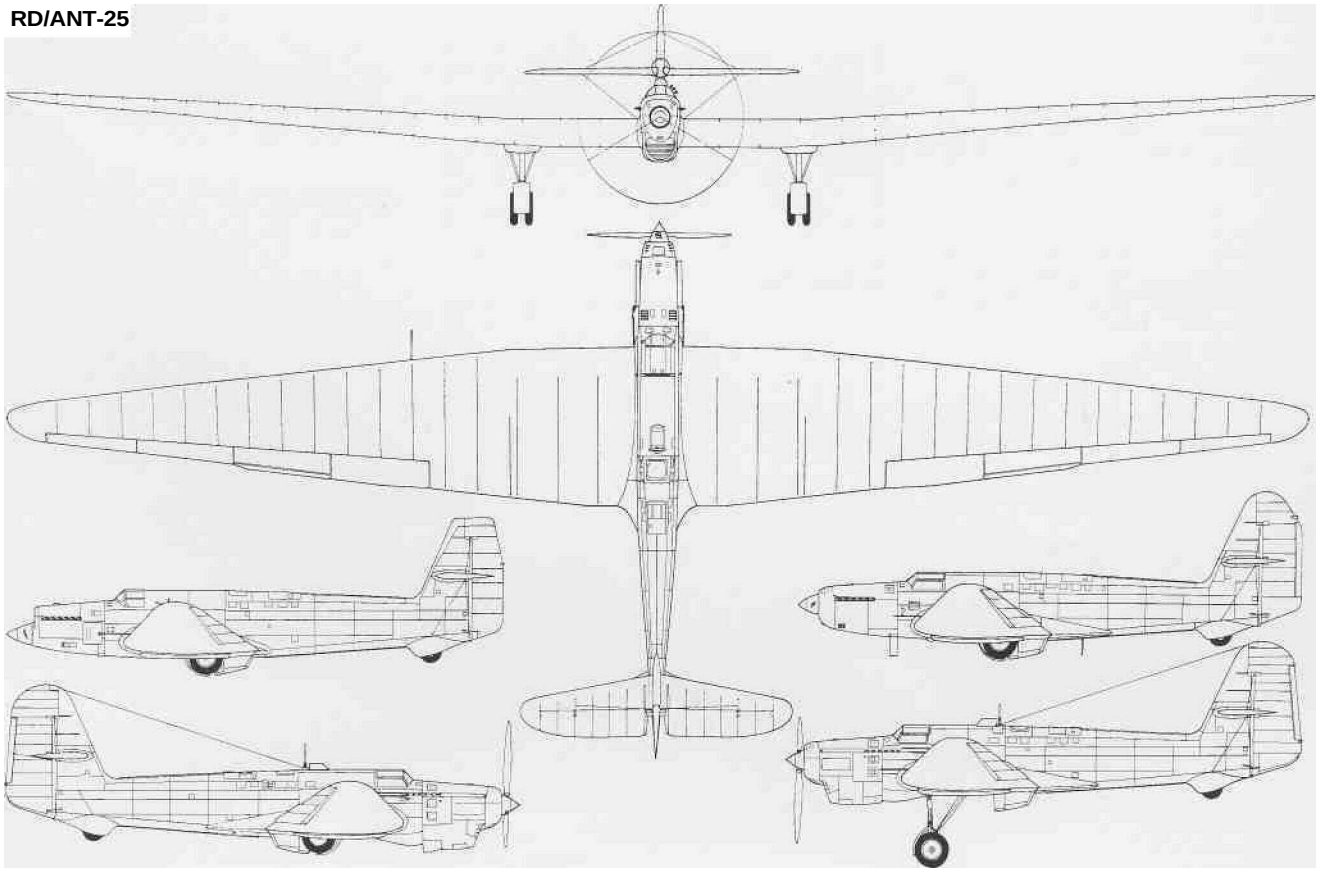
Only the rate-of-climb near the ground with the landing gear extended was unchanged. On June 20, 1936, the heavily loaded aircraft, after a ground run of more than 4,921 ft (1.5 km), gradually lifted off and began climbing. The aircraft crew, led by Valery Chkalov with co-pilot Georgy Baydukov and navigator Aleksandr Belyakov, flew to Petropavlovsk-Kamchatsky.

After the long duration flight, the pilots decided to continue. However, because the weather became worse, pilot V. Chkalov had to land the aircraft on a narrow spit of sand on Udd Island. The crew was in the air 56 hours and 20 minutes flying 5,825 miles (9,374 km). All of the flight participants were declared Heroes of the Soviet Union for their flight.

This flight revealed how great a danger that icing of the aircraft, especially of the propellers, might constitute. Soon, the propeller was fitted with the first Soviet de-icer which was developed by the TsAGI. Crowds gathered at the traditional air parade in 1936 and enthusiastically welcomed the ANT-25 and its crew, Valery Chkalov, Georgy Baydukov and Aleksandr Belyakov.

The heroes dropped a message bag

**RD/ANT-25**



with greetings By government decree, the ANT-25 was among the Soviet exhibits presented at the World Airshow in Paris in November 1936 There, it proved a popular attraction and was one of the highlights of the show

Meanwhile, the crew was getting ready for a long endurance flight Early in the morning of June 18, 1937, a takeoff was cleared from the Schelkovo airfield near Moscow and the aircraft headed For the North Pole The flight was completed at 19 20 Moscow time on July 20 The aircraft landed at the Baracks airfield near the town of Portland, Washington, in the United States This nonstop flight was unparalleled in aviation history as it had lasted 63 hours and 25 minutes A distance of 3,666 miles (5,900 km) had been covered over oceans and ice Due to unfavorable weather, the flight altitude had been at or above 13,123 ft (4,000 m) Several thousand kilometers had been flown blind

The names of the heroes were in the newspapers and magazines all over the entire world for several weeks The world greeted Valery Chkalov, Georgy Baydukov and Aleksandr Belyakov enthusiastically

Three weeks later, a new flight was made with the ANT-25 across the North Pole to the USA The crew was headed by the Hero of the Soviet Union Mikhail Gromov who established a world range record with this flight Gromov landed the aircraft at a field located three kilometers from San Jacmto, California The aircraft had been in the air 62 hours and 17 minutes covering a range of 7,146 miles (11,500 km) This achievement was not surpassed until the end of 1946

The historic flights had shown to the entire world not only the courage, fortitude and skill showed by the pilots but also the high status of the Soviet aircraft industry In a technology newspaper, Pavel Sukhoi gave the following data on the aircraft "The ANT-25s are built exclusively from the high-grade materials The world of aeronautical engineering does not know of an aircraft of similar kind with such a great wing span The wing aspect ratio of the ANT-25 is approximately 30% more than that of aircraft of similar types which have been built, both in the West-European countries and America before now"

**RD (ANT-25) AIRCRAFT DESIGN**

The RD was a cantilever low wing monoplane with a wing aspect ratio of 13 3 and a span 2 5 times greater than the fuselage length

**Fuselage:** The fuselage consisted of two parts A forward section was made integral with the wing center section and a tail section was of oval cross-section monocoque design The transverse framework was composed of stamped frames The frames and stringers were of L shape

The fuselage skin was smooth and was made of 0 04 in (1 0 mm) and 0 07 in (1 8 mm) thick aluminum Rivet heads projected outside the skin Four longerons were riveted above the skin and ran through the entire tail part of the fuselage

The cockpit, with all necessary equipment was aft of the engine Navigator's and copilot's stations were located behind the joint between the forward and tail fuselage sections All of the cabins were lined with broadcloth on the inside

**Wing:** The primary structural components of the wing of ANT-6 section were three truss spars and stringers The wing transverse structural members included 18 ribs (per each half wing) which were made of tubes All the structural members were made from Duralumin sections, XMA alloy chromium-molybdenum tubes and refined steel forged pieces The first two spars were interconnected by the structures of six fuel tanks spaced between the ribs which formed strong torsion boxes

Wing skin, except for the torsion box area, was from corrugated aluminum for stiffness Emergency ditching equipment was located in the wing leading edges In an emergency, the aircraft not only could land on water uneventfully but also could remain afloat For this purpose, fuel from some tanks was dumped and special rubberized fabric bags were filled with air to provide extra buoyancy

The four section mass and Flettner (servo tab assisted) balanced ailerons were hinged to the third auxiliary spar The aileron surface was covered with linen

*During one record attempt,* f/ieDoubler *was forced to make an emergency landing on Udd Island The aircraft was successfully recovered without serious damage to the airframe*

*OnJune 18 1937* f/ieDoubler *departed Schelkovo airfield on a record flight to America across the North Pole The flight took 63 hours and25 minutes to complete*

*LtoR Doublet crew members A Belyakov, V Chkalov, and G Baydukov*

*LtoR Doubter crew members Gromov, Yumashev, and Daml/n Gromov already was a Hero of the Soviet Union one of the highest honors afforded a Russian citizen at the time*

San Jacinto Valley Museum

*Gromov s aircraft landed in an empty flat field only a few miles from downtown San Jacmto California The aircraft proved a noteworthy attraction for virtually everyone within walking or driving distance of the field and hundreds visited the landing site during the several days the aircraft was statically parked*

**Empennage:** Tail surfaces were all-metal with a corrugated skin The control surfaces were aerodynamically balanced and were provided with Flettnertabs Unlike the first RD aircraft, the corrugated wing and tail unit skins of the second prototype were covered with linen and coated with aircraft dope

**Landing Gear:** The main landing gear fitted with oil- pneumatic shock absorbers, was attached to the first spar Operation was by an electric actuator which was used for the first time in the USSR While inflight the wheels were semi-retracted The outer portion of each wheel was enclosed in a fairing to reduce drag Dual wheels were fitted to each landing gear leg Mam wheel size was 35 4x7 87 in (900x200 mm) The wheel track was 23 9 ft (7 28 m) All but the bottom half of the tail wheel was covered by a fairing

San Jacinto Valley Museum

*Shiny wing undersurface the result of covering the metal with cloth and then painting for smoothness is readily apparent in this view of theDoubler following its San Jacinto California*

Sukhoi

*Following its record-setting flights, the ANT-25 was returned to Russia by boat It is seen during a low-altitude flyover of the 1937 Tushino airshow*

**Powerplant:** The aircraft was initially powered by the AM-34 12 cylinder water-cooled 750 hp (559 kW) engine with a compression ratio of 6 0 During the flight tests it was replaced with an M-34 engine uprated to 847 hp (652 kW) with a compression ratio of 7 0 The second prototype was equipped with an M-34R geared engine to improve engine efficiency by reducing the propeller speed The M-34R had a compression ratio of 6 0 and its power was initially equal to 800 hp (597 kW) The aircraft flown by the Valery Chkalov crew was fitted with the M-34R engine uprated to 950 hp (708 kW) A modular aluminum engine structure with a so-called "dry crankcase" dramatically decreased oil consumption Continuous engine operation for 80 to 100 hours was possible

Various metal two and three bladed propellers were installed and tested on the aircraft A three bladed, ground adjustable propeller with polished blades was used for the flights during 1936

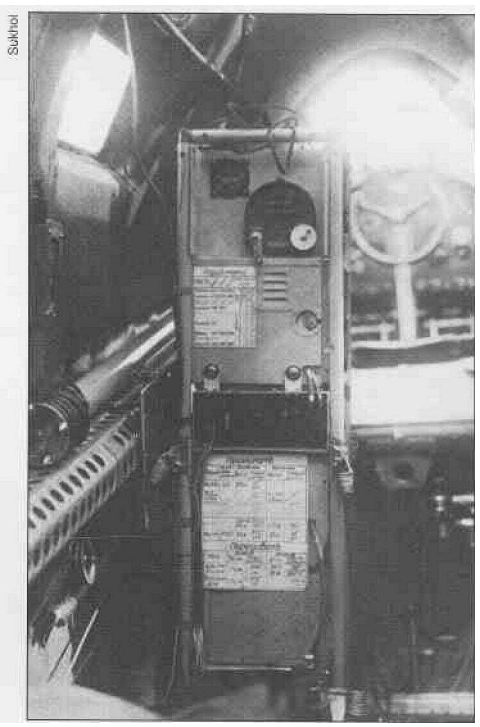
The fuel system consisted of the center tanks of 1 340 gal (5,072 l) capacity, intermediate tanks containing 878 gal (3,323 l), extreme tanks with 589 gal (2,229 kg) and a service fuel tank with 44 gal (167 l) Total capacity of the fuel system was 2 851 gal (10,791 l) Fuel distribution was such that any of the tanks could supply the engine

The main oil tank contained 265 gal (1,003 l) of oil and the service tank held 55 gal (2081)

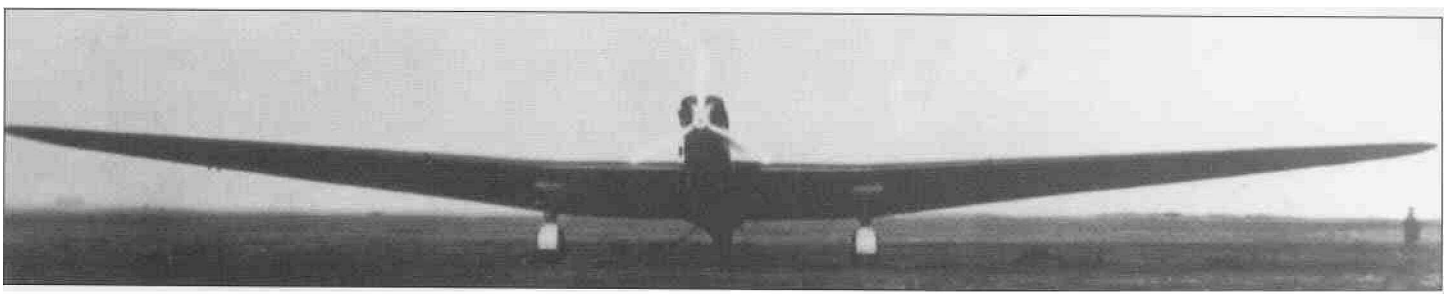
The engine was water cooled Initially the radiators were arranged in the wing However the wing-mounted radiators were subsequently replaced with a single unit which was installed under the engine The new radiator had improved air flow that was regulated by pilot controlled intake shutters and an adjustable exit flap

**Equipment:** Besides the mam mstru-

*A reduced scale mock up of the ANT-25 was built for a movie about the world record distance flights the aircraft had flown Except for scale it s difficult to differentiate this reproduction from the original*




*The ANT 25 s radio station was located just aft of the pilots seat on the port side of the aircraft*



*The military version of the ANT 25 which has rarely been seen was designated RD-VV or DB-1 (the designation ANT 36 also was assigned[1]) About twenty of these aircraft eventually were built and sparingly utilized as long range bombers by the Russian air force*

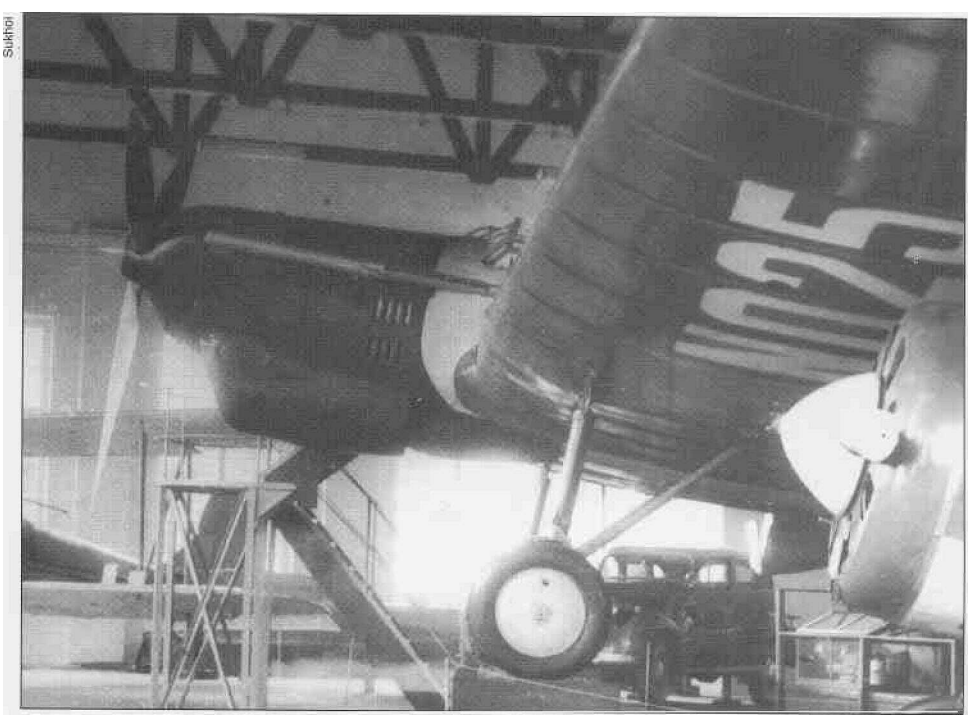
ments, the equipment also included blind-flying instruments A Soviet built gyro-magnetic compass was installed for the first time The radio equipment incorporated a transceiver with a total weight of about 1 1 0 lb (50 kg), which provided the capability of communicating at a range of 3,107 to 3,728 miles (5,000 to 6,000 km) Normal and emergency power supply units and aerials as well as a foldable telescopic mast intended for operation in case of an emergency landing were carried In addition to the running lights, the aircraft was furnished with equipment for igniting and dispensing underwmg flares

For the first flight the copilots position was equipped with an additional set of controls and instruments Thus, it was possible to fly the aircraft from that position

For astro-orientation, use was made of an octant which only slightly differed from a sextant but was more convenient than the latter The octant was fitted with a double chronometer to show mean and sidereal time The aircraft intended for the Valery Chkalov crew had more advanced equipment

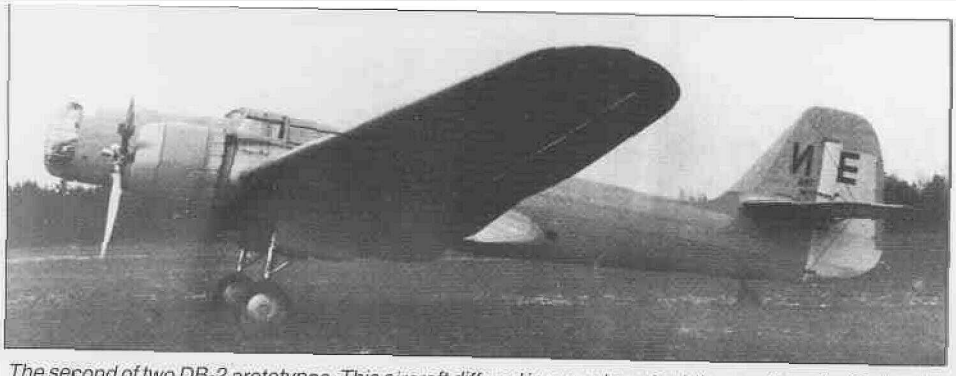
**DB-1 (RD-VV, ANT-36) LONG RANGE BUMBthf**

The world records brought fame to




*The original record-setting ANT 25 has been preserved It is displayed--along with other memorabilia--in the Valery Chkalov museum m Chka/ovsk Russia*

The prototype DB-2 long-range bomber. Developed as a more practical alternative to the military version of the ANT-25, it utilized the same high-aspect ratio wing philosophy that had led to the successes of its record-setting predecessor.



The second of two DB-2 prototypes. This aircraft differed in a number of subtle ways from the first prototype. One of the most noticeable was the utilization of three-bladed propellers.

Soviet aviation Notwithstanding, each new step forward was of much greater importance to military aviation than to civil aviation

It was natural that Pavel Sukhoi used the RD design to create a long-range bomber Production of a small batch of these aircraft was started They were designated the DB-1 or RD-VV

The Voronezh factory made about 20 DB-1 (ANT-36) aircraft That was the first Soviet long-range bomber

However, the concept of a long-range bomber changed with time and the DB-1 did not go into service Various kinds of prototypes were built based on the production aircraft

High-aspect-ratio wing gave the DB-2 exceptional long-range performance while carrying a relatively modest complement of bombs. Only two aircraft were completed before the program was terminated as a result of the crash of the first prototype.

The second DB-2 was tested at the NII VVS facility. Nose compartment accommodated the navigator/nose gunner position. Wide stance of twin-wheel main landing gear is noteworthy.

The third and final DB-2 prototype was the first production standard aircraft to be completed. It differed little from the second prototype. Though performance was reasonable, only range was considered to be excellent. Accordingly, the DB-2 was shelved with the completion and flight testing of this aircraft.

## DB-2 (ANT-37) LONG RANGE BOMBER

After a futile attempt to make an effective bomber from the record-setting RD (ANT-25) aircraft, the DB-2 (ANT-37) long-range bomber was developed by the Sukhoi team using whatever parts they could use from the RD aircraft This airplane was equipped with two M-85 engines rated at 800 hp (597 kW) each and it had to be capable of *a* range of 3,107 mi (5,000 km) with a 2,205 lb (1,000 kg) bomb load at the standard flight weight of 20,847-25,353 lb (9,456-11,500 kg) General leadership of the project was carried out by Andrei Tupolev himself

Two prototypes of the aircraft were being built simultaneously The first one was ready on June 16, 1935, and its flight test program began immediately On June 20, the aft part of the fuselage was destroyed during a flight because of production defect in the stabilizer trim jack Though the test pilot K Popov and the leading engineer M Yegorov managed to escape successfully, the third crew member, a technician, died in the crash The result of this unexpected accident was an increased emphasis on further scientific research on flutter and buffet in order to eliminate these phenomena

Although the second DB-2, the second prototype, had a wing root fairing and a reinforced fuselage, its TOGW did not change considerably That aircraft was test-flown at Nil VVS and demonstrated a range of 3,107 mi (5,000 km) with a 2,205 lb (1,000 kg) bomb at the average speed of 132 mph (213 km/h) This performance, except for range, was not sufficient in 1936 to justify full scale development for service with the Air Force

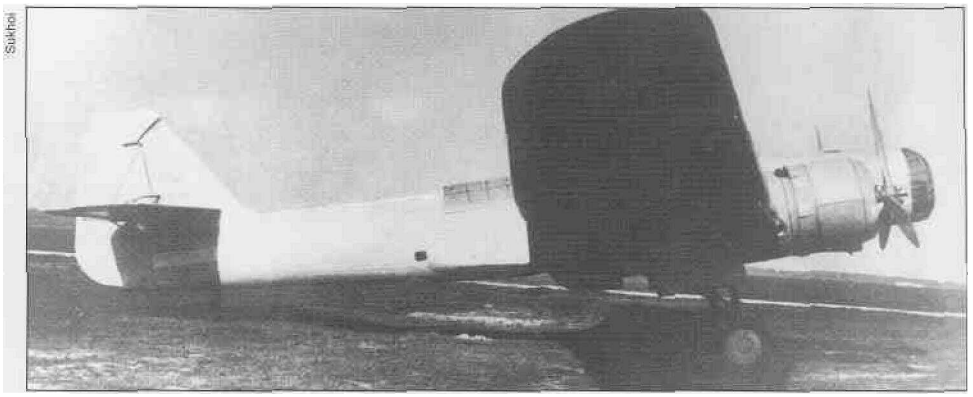
## ANT-37BIS ("RODINA") RECORD AIRCRAFT

Because of government instructions, the DB-2 was redesigned to meet the requirement of a long-range (4,350-4,971 mi)(7,000-8,000 km) airplane The DB-2 airframe was little changed, but more powerful M-86 engines, rated at 950 hp (708 kW) at *sea* level and 800 hp (597 kW) at an altitude of 26,247 ft (8,000 m), were installed as well as three-bladed propellers All armament was removed, fuel tank volume was increased and other changes were made before the record flight This third prototype of the DB-2 airplane finally built in February 1936, had been given its own proper name, *Rodma* (Motherland) All the work was carried out by the Sukhoi team Pavel Sukhoi himself was the creator of this aircraft The fourth prototype, the *Rodina* version with a wet wing, also was being built It was designed for even longer range flights However, the airplane was never completed

The *Rodina* airplane design and equipment were more sophisticated than those of previous Soviet military and record aircraft The wing and empennage were covered with smooth skin

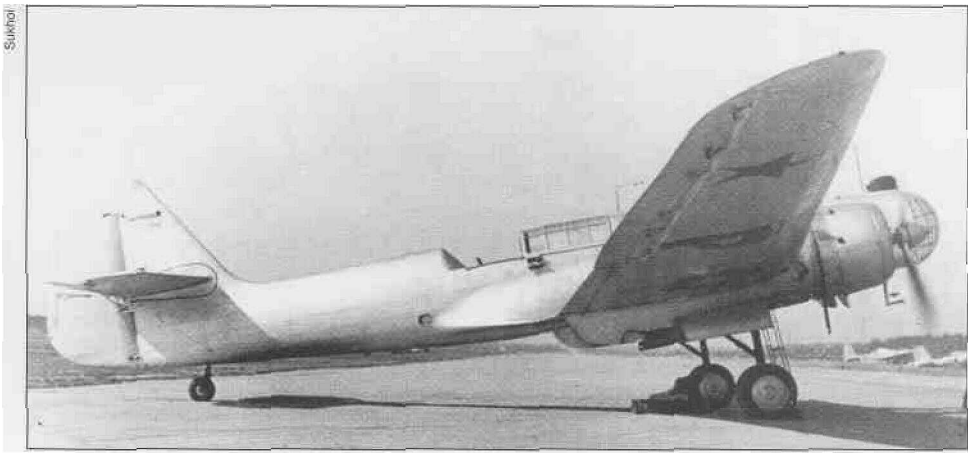
Fuel tanks were placed inside the fuselage Spars were made of metal tubes Streamlined wires braced the stabilizer to the fuselage and fin The landing gear retracted to the rear into the nacelles Landing gear control was electrical for the first time in the USSR

On September 24-25, 1938, the world distance record for an aircraft with an all-

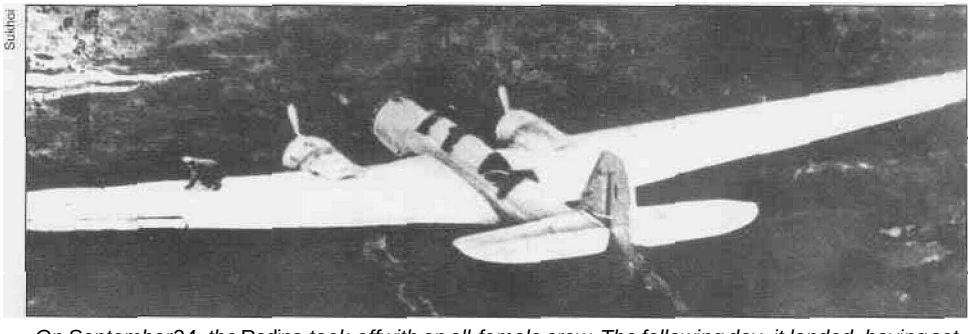



*Production of the DB-2 was limited to the two prototypes and single production example The type was never introduced into the operational Russian air force inventory*

*The third DB-2 (seen being preparedforflight) became* f/ie Rodina (Motherland) *record setting aircraft It was also referred to as the ANT-37bis*




*The* Rodina *was the first of the record-setting long-range aircraft to have a non corrugated wing surface A fourth DB-2, also for distance flying was never completed*



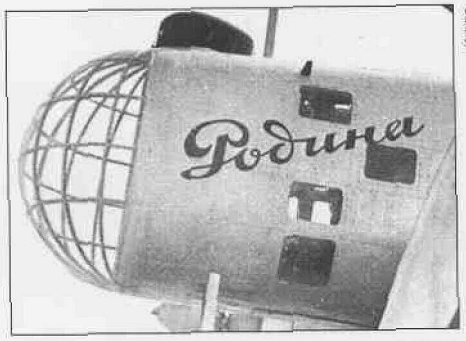

*On September24, the* Rodina *took-offwith an all-female crew The following day, it landed, having set a world distance record for gender Time aloft was 26 hours and 29 minutes*

L to R: V. Grizodubova; P. Osipenko; and M. Raskova standing next to Rodina prior to their world-record-setting flight.

Pavel Sukhoi discusses the world record flight with Grizodubova, Osipenko, and Raskova. Rodina is visible in the background.

Pavel Sukhoi, seen in the middle facing the camera, witnessed the departure of the female crew at the beginning of their record-setting flight.

The female distance record was considered a major event in the history of pre-war Russia.




The word Rodina was painted on the nose of the ANT-37bis prior to its record-setting fights.

**RD (ANT-25) RD (ANT-25 *DOUBLER),* DB-2 (ANT-37), AND *RODINA* (ANT-37 bis) SPECIFICATIONS AND PERFORMANCE**

| | RD (ANT-25) | RD (ANT-25 *DOUBLER)* | DB-2 (ANT-37) | *RODINA* (ANT-37b!S) |
|---|---|---|---|---|
| **Powerplant** | M 34 | M34P | 2xM 85 | 2xM 86 |
| **Horsepower (kW)** | 750(559) | 950 (708) | 800(596) ea | 950 (708) ea |
| **Wingspanft(m)** | 1115(34) | 1115(34) | 1089(332) | 101 7(31) |
| **Length ft (m)** | 4356(1328) | 4543(1385) | 492(15) | 492(15) |
| **Wheel track ft (m)** | 23 9 (7 28) | 23 9 (7 28) | (?) | (?) |
| **Wing area ft² (m²)** | 949 3 (88 2) | 949 3 (88 2) | (?) | 9149(85) |
| **Aileron areaft² (m²)** | 75 88 (7 05) | 75 88 (7 05) | (?) | n |
| **Tailplane area ft² (m²)** | 10063(935) | 10063(935) | H | (?) |
| **Fin area ft² (m²)** | 59 73 (5 55) | 5489(51) | 24684(11 200) | H |
| **Takeoff gross weight lb (kg)** | 17632(8000) | 24795(11 250) | 127832(5800) | 27550(12500) |
| **Empty weight lb (kg)** | (?) | 9 1686(4160) | n | 12 904 4 (5 855) |
| **Fuel weight lb (kg)** | (?) | 17103(7760) | 227(111 3) | 12 177(5525) |
| **Wing loading lb/ft² (kg/m²)** | (?) | 2628(1288) | 130(59) | 300(147) |
| **Power loading lb/hp (kg/hp)** | (?) | 2755(125) | 187(301) | 14 55 (6 6) |
| **Max speed mph (km/h)@ s l** | 121(195)w/gear attached<br>169 (272) w/gear retracted | (?) | | 186(300) |
| **Ceiling ft (m)** | 27 092 (8 260) | 23288(7100) | (?) | (?) |
| **Endurance (hr)** | 48 | 80 | (?) | 4 533 (7 300) |
| **Range mi (km)** | 4 471 (7 200) | 8 073 (1 3 000) | 3182(970) | 3280(1 000) |
| **Takeoff distance ft (m)** | (?) | 5215(1 590) | 1 000 kg bombs | (na) |
| **Armament** | (na) | (na) | | |

*An approximately two-thirds scale replica of the ANT-25 is displayed at the Russian Air Force Museum atMonino The mock-up is accurately painted in cream red and black and is finely detailed Even in scaled-down form it is a huge machine*

female crew was established in the ANT-37bis *Rod/na* by Valentina Gnzodubova Polina Osipenko and Manna Raskova The record breaking flight took place along the route from Moscow to Kerby Village which was 3 671 mi (5,908 km) long The flight took 26 hours and 29 minutes to complete After that flight the airplane was operated by *Aeroflotand* later up to 1943, as a research platform by an aircraft factory in Moscow

*Another view of the approximately two-thirds scale ANT-25 replica at Monmo Construction materials appear to be a mix of metal, fiberglass and wood Building in which the ANT 25 is displayed dates to The Great Patriotic War (World War Two)*